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Reducing Cost of Docking Work

The Methods Employed at the Portsmouth Navy Yard and Some of the Results

By Naval Constructor G. A. Bisset

THE cost of docking and routine work at the navy yards in the United States has in the last few years been receiving considerable attention. As a result of this attention there was a total saving in 1912 of about $52,000 over the charges for 1911.

For the purpose of comparison all vessels docked are divided into classes—above 8,000 tons; 3,000 tons to 8,000 tons; 1,000 tons to 3,000, etc. etc. The docking costs for each fiscal year are compiled and tabulated and under each class for each year is given the percentage over or under the average cost at all the yards. For instance the cost at Portsmouth of docking vessels between 100 and 500 tons was 27 per cent below the average.

While these costs are very interesting and have resulted in great economy they are not an absolute measure of the docking efficiency at the different navy yards. This will be understood from a perusal of the standard docking job orders which are as follows:

No. 1. Dock and undock.

No. 2. Rig stages and clean bottom.

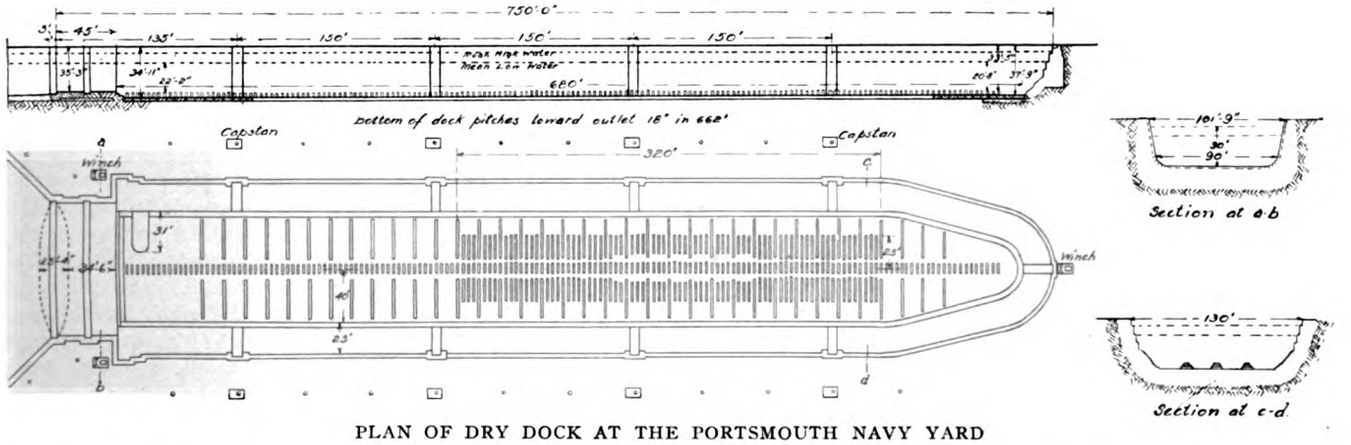
No. 3. Overhaul sea valves and zincs.

No. 4. Paint bottom.

No. 5. Inspect bottom and make minor structural repairs.

Of these it will be noted that the jobs "Overhaul sea valves and zincs" and "Inspect bottom and make minor structural repairs" cover an indefinite amount of work and the costs for different vessels and at different yards are not fairly comparable. In other words, the cost does not depend upon the efficiency of the navy yard doing the work, but rather upon the work that is to be done upon the ship involved. It is found that the cost of work on these job orders varies enormously.

The other jobs offer a fairer indication of efficiency. These jobs being "Dock and undock," "Rig stages and clean bottom" and "Paint bottom." The exact work on these jobs is not, however, an absolute measure of efficiency either, some of the reasons being: It may be necessary sometimes to dock a small boat in a large dock, thereby causing the power charges of pumping out to be abnormally high. The facilities of handling the lines may be inadequate, that is no electric capstans or capstans out of repair. The bottom may be unusually foul or considerable scale may have to be removed. The paint may be in a varying condition, from that in which the bottom needs only one coat of anti-fouling paint to that condition which requires two coats of anti-corrosive paint and two coats of anti-fouling paint. There is given herewith a method introduced by the writer at the Portsmouth yard. This method it is believed will result in causing a great reduction in cost of docking at this yard. The saving at Portsmouth in 1912 over 1911 amounted to about $6,000 out of a total cost of under $16,000. These results have been accomplished as follows:



PLAN OF DRY DOCK AT THE PORTSMOUTH NAVY YARD

The "Docking program" was prepared and a copy furnished to each interested person. This "Docking program" reads as follows:

1. The sketch below shows the lines to be run by the yard force in docking a vessel. Lines 1 to 8 are

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Form D. ..... Sheets; Sheet No. 1.

PLAN OF WORK

Planning Section, Prepared by .....
Division, ... 19.....
Location: Letter No. ..... Item No.:
Dated: 19

ITEM: J. O. U. S. S.

Dock and undock.

Aux. J. O. No. 1. Shipwright.

Prepare #2 dry dock for the docking of the U. S. S. in accordance with templets on hand and data from drafting room. Assemble shores, blocks, wedges, sighting battens, plumb bob, centering float and all other necessary docking equipment. Test the hauling gear of bilge blocks before the dock is flooded. Furnish labor to do the shoring and centering necessary during the docking and undocking.

2. Foreman Laborer.

Furnish labor to assist shipwright to prepare dry dock #2 for docking of U. S. S. Furnish the necessary lines for hauling and securing the caisson and ship in dock. Assign your force to their various duties, such as removing and installing life lines, caisson, linemen and etc., in accordance with previous instructions for docking vessels.

3. Electrician. (Power Plant)

Furnish labor to operate dry dock pumps, winches and windlass during the docking and undocking of the U. S. S.

4. Hull Machinist

Furnish labor to operate caisson pump and flood valves under direction of the officer in charge during the docking and undocking of the U. S. S.

hook ropes which are hooked into mooring staples by the yard force. Line 9 is a head line, the end of which is brought to the ship by boat, the end being secured on board by the ship's force.

2. In addition to the lines shown, there will be, on windy days, two "preventures" to windward, one on the bow and one on the quarter, about as shown dotted, these being handled under the supervision of the yard force.

3. Colored badges with numbers will be provided, eight in number, to be kept in charge of the foreman laborer and issued when docking vessels to the men in charge of the eight lines, these badges being worn on the arm of the line men for the eight lines as follows:

No. 1—Green. (The badge to have the number 1 and to be green in color.)
No. 2—Green.
No. 3—Orange.
No. 4—Orange.
No. 5—Black.
No. 6—Black.
No. 7—Blue.
No. 8—Blue.

It will be the duty of each line man to care for the hook rope which bears his number and color, the hook rope having secured to it at a distance of about 15 ft. from the hook a badge having the same number and color as the line man wears. Each line man will see that his hook rope is hooked at the point designated by the foreman laborer and tend it until the vessel is landed on the blocks, never leaving his line until that time. Without awaiting an especial order, he will, when his line tends about 45 degrees abaft the beam, fleet forward to a point which brings his line about 45 degrees forward of the beam, *taking care* that the other bow or quarter line, as the case may be, is taut before he throws off his line, and fleets forward.

4. The flooding of the dock and the handling of the caisson will be in charge of a warrant officer—chief carpenter preferred. Under his orders will be the machinist who runs the pump and a gang of seven men with two riggers in charge, the gang splitting up when the caisson is out into two gangs, four to the starboard side and three to the port. There will be three men from the ship's force in each gang. There will also be two yard men, one on each side of dock for handling and securing lines to caisson. When the caisson is disposed of, these men will join line men 7 and 8. Immediately upon the stern of the vessel's clearing the dock sill, these men will proceed immediately to get the caisson back into place, the rigger in charge of each side getting out and preparing the necessary tackles for hauling the caisson into exact position. The main duty of these nine men with the two riggers will be to care for the caisson, the work on lines 7 and 8 being merely fill-in work. In connection with flooding the dock the chief carpenter will use his discretion in opening culvert valves (and the pump valves in the pump house). He will also start to raise the caisson by pumping it out when the difference in water level inside and outside the dock is not over 1 ft. In bringing the caisson back into position after the vessel is in the dock, the culvert valve should be left open until the caisson has sunk into place.

5. The senior officer afloat is requested to send ashore, to assist the line men, six men for each line, the 48 men being detailed on board ship to report to No. 1, green, No. 2, green, etc., for the eight lines. Two men should also be detailed on each preventer line on shore when used,

HULL DIV. AUX. JOB ORDER FORM L.
J. O. NO..... SERIAL NO..... TO FOREMAN OF SHOP.....
MASTER

Foreman Laborer.

Furnish labor to assist shipwright to prepare dry dock #2 for docking of U. S. S. Furnish the necessary lines for hauling and securing the caisson and ship in dock. Assign your force to their various duties, such as removing and installing life lines, caisson, linemen and etc., in accordance with previous instructions for docking vessels.

RECEIVED.....
WILL BE COMPLETED..... DESIRED COMPLETED.....
WAS COMPLETED..... 191..... LEADING MAN..... FOREMAN

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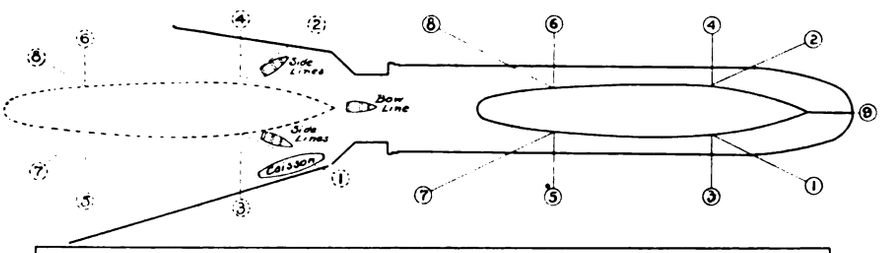
two men on head line, two men to each of two boats for hook rope and six men for caisson gang—total 64 (at least). The 16 men should report under a petty officer, at the caisson to the docking officer. There should be three petty officers (deck force) with this squad.

6. The 40-ton crane will be in position to put up the forward brow as soon as the vessel reaches her final position in the dock and will put the brow on board at once before the vessel lands, the foreman shipwright having previously indicated which brow will go forward and which aft.

7. The foreman shipwright will previous to docking, provide lighting patterns at the head of dock, on caisson and on starboard and port sides of dock in line with the final position of the bow of the ship. He will also provide a plumb bob and chain for centering the vessel aft. In laying off the position of the vessel in connection with preparing blocking, the table prepared by the chief draftsman, Fig 1, will arrange that when the vessel has reached her final position in the dock hook ropes 1 and 2 and 5 and 6 will bear abeam, when these ropes are led to capstans or bollards. It must be borne in mind that the hook ropes must be hooked in the available mooring staples. It is necessary that these lines bear abeam in order to facilitate centering the ship without hauling her forward or aft. The foreman shipwright will also paint a white stripe on the port side of dock, abreast the stem, with the name of the vessel and date of docking. This is necessary in order that at the next docking provision can be made for making accessible the parts of the bottom plating which were inaccessible on account of being on the blocks at the last docking. Electricians are not required to operate the electric capstans and winches. These may be operated by the linemen, who must be careful never to leave the controller handle on the first notch, for fear of burning out the resistance. The foreman laborer will have each lineman instructed in the operation of the motors.

8. The dock pumps will be started on signal of the docking officer after the caisson is sunk into place. Unless particularly directed to the contrary, in individual cases, two pumps will run full speed until all the water in the dock has been pumped out, provided that the men on the floats cleaning the bottom can keep up. In order not to get too far ahead of these men, the pumping may be slowed down, but the total time of pumping out the dock from landing of the vessel must not exceed two hours.



DOCKING BILL

	HEAD LINE No 9.	
PORT LINE No 2	GREEN	STARBOARD LINE No 1
LINE No 4	ORANGE	LINE No 3
LINE No 6	BLACK	LINE No 5
LINE No 8	BLUE	LINE No 7
BOAT	BOAT CARRY HEADLINE TO SHIP	BOAT
CAISSON		CAISSON
CAISSON LINES		CAISSON LINES

← 49" →

9. One scraper and one wire brush will be provided by the foreman laborer for each man of the ship's force assigned to floats, if the number will be stated in advance by the commanding officer of the vessel, or, in case of small crews, by the senior officer afloat. An officer of the vessel is required to sign for these articles. It is suggested that the cleaning party be divided into four gangs, the bottom being divided into quarters.

10. Where shores are required, the shipwrights will provide the necessary shores, and place them alongside the dock at their proper locations before docking. These will be placed where indicated in the table figures prepared by the chief draftsman, and will be of the lengths there specified. They will also prepare the bilge blocks. They will mark the rail of the vessel with chalk marks visible from the outside, to show where the lines for the shore ends are to pass or be secured. The lines will be carried to the vessel by two boats, each manned by two men, one of the men in each boat being a yard man. Before the vessel goes into dock, the foreman laborer will secure tackles, at the chalk marks, for hauling up the shore ends. The boat men will hook these tackles and carry the hauling part ashore, and later the shore ends will be hauled up by the gang on shore. Both shore lines will be hauled under the direction of the "linemen," each of whom will take

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charge of this work on the lines that are nearer to him than to any other line man. The linemen will, in a similar manner, look out for hauling the bilge blocks, these blocks to be hauled however, *only* when ordered by the docking officer. The shipwrights will wedge the shores, one man on each side of dock looking out for this work.

11. As soon as the vessel has landed, the line men will proceed to rig stages, the stages having previously been provided in necessary numbers and laid out on the side of the dock.

International Conference on Safety at Sea

Secretary of Commerce William C. Redfield has made further preparations for the international conference on safety at sea by designating several committees composed of officers of the government to consider the various topics prescribed by the Alexander resolution.

He believes that these committees should include also representative shipbuilders, ship owners and ship captains, representatives of the maritime exchanges and chambers of commerce, of organizations of licensed deck officers and engineers, and of American seamen, of the technical schools, marine underwriters, wireless companies, New England deep sea fishermen, and others. For the past month he has been in touch with representatives of these maritime interests so as to be able to designate complete committees as soon as congress acted.

The deficiency appropriation act of March 3, 1905, forbids any department to accept voluntary service for the government or employ personal service in excess of that authorized by law, except in sudden emergency involving loss of life or property. Efforts last January and during April to secure a small appropriation for the work failed, and Secretary Redfield believes that preliminary work cannot wait any longer. A further effort to secure $5,000 or $10,000 may be made later. The work of the committees designated will be under the general direction of Commissioner of Navigation E. T. Chamberlain, representing Secretary Redfield for the purpose.

The treasury, war, navy and agriculture departments are co-operating with the secretary of commerce in this preliminary work. The committee on bulkheads and hull construction comprises Rear Admiral W. L. Capps, U. S. N., former chief of the construction bureau; Constructor David W. Taylor, U. S. N., and George Uhler, supervising inspector general of the steamboat inspection service. James Donald, naval architect, of the Fore River Shipbuilding Co., will be consulted as the representative selected by the shipbuilders and shipowners.

Gen. Supt. S. I. Kimball, of the life saving service, Gen. Uhler and Capt. D. P. Foley, of the revenue cutter service, comprise the committee on lifeboats, davits, life rafts and life preservers. Capt. Foley will also act on the committee on efficiency of officers and crews, with Capt. Henry M. Seeley, supervising inspector of the New York district, and Asst. Surg. Gen. W. J. Pettus, of the public health service.

The committee on fire protection temporarily will consist of Gen. Uhler and Supervising Inspector Nils B. Nelson, of the Cleveland district, who will soon proceed to New York to consult with marine underwriters and others directly concerned, and will also co-operate with the hull construction committee.

The committee on aids and perils to navigation, covering ocean lanes, dangers from ice and derelicts, searchlights, rules of the road, dissemination of storm and weather signals, and similar subjects, consists of Capt. Commandant E. P. Bertholf, of the revenue cutter service, Commander George F. Cooper, U. S. N., hydrographer, Commissioner of Lighthouses G. R. Putnam, and Prof. Alfred J. Henry, of the weather bureau.

The committee on radiotelegraphy includes Commander W. H. G. Bullard, U. S. N., superintendent of the naval radio service; Maj. C. McK.. Saltzman, U. S. A., of the signal corps; Constructor J. Q. Walton, U. S. R. C. S.; Dr. Frederick Kolster, of the bureau of standards, and Commissioner of Navigation Chamberlain.

The committees will organize within the next few days, and by consultation and correspondence secure a body of intelligent opinion on the various subjects involved for the use of the American delegation to the international conference at London late in the autumn. The delegates to the international conference will probably not be selected before June or July.

DOCKING DATA - Navy Yard, Portsmouth, N.H.

The U.S.S._____ will be docked_____ in No. 2 Dock

The forward perpendicular (_____) to be located

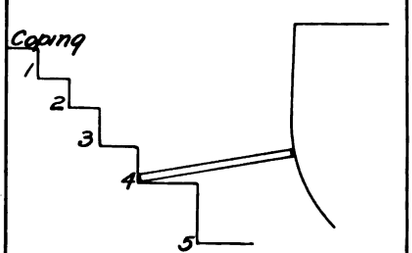
_____ of Dock Frame No _____

Offsets for Bilge Blocks

Location Dock Fr. No	a	b	Ship Fr. No

Location & Length of Shores

Location Dock Fr. No	l	d	Altar No	Ship Fr. No



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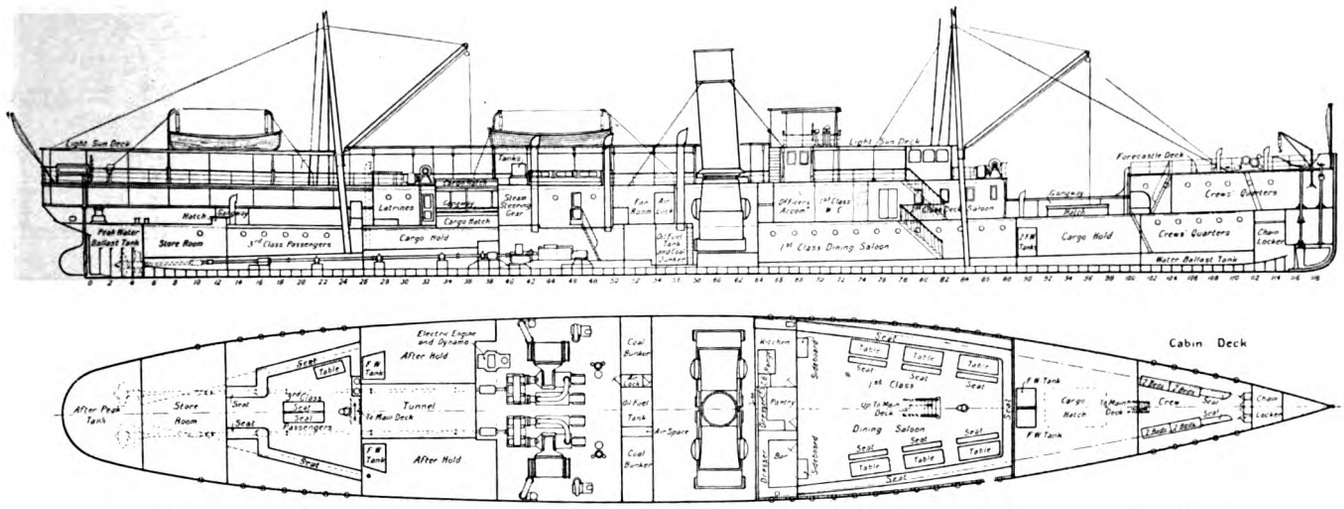


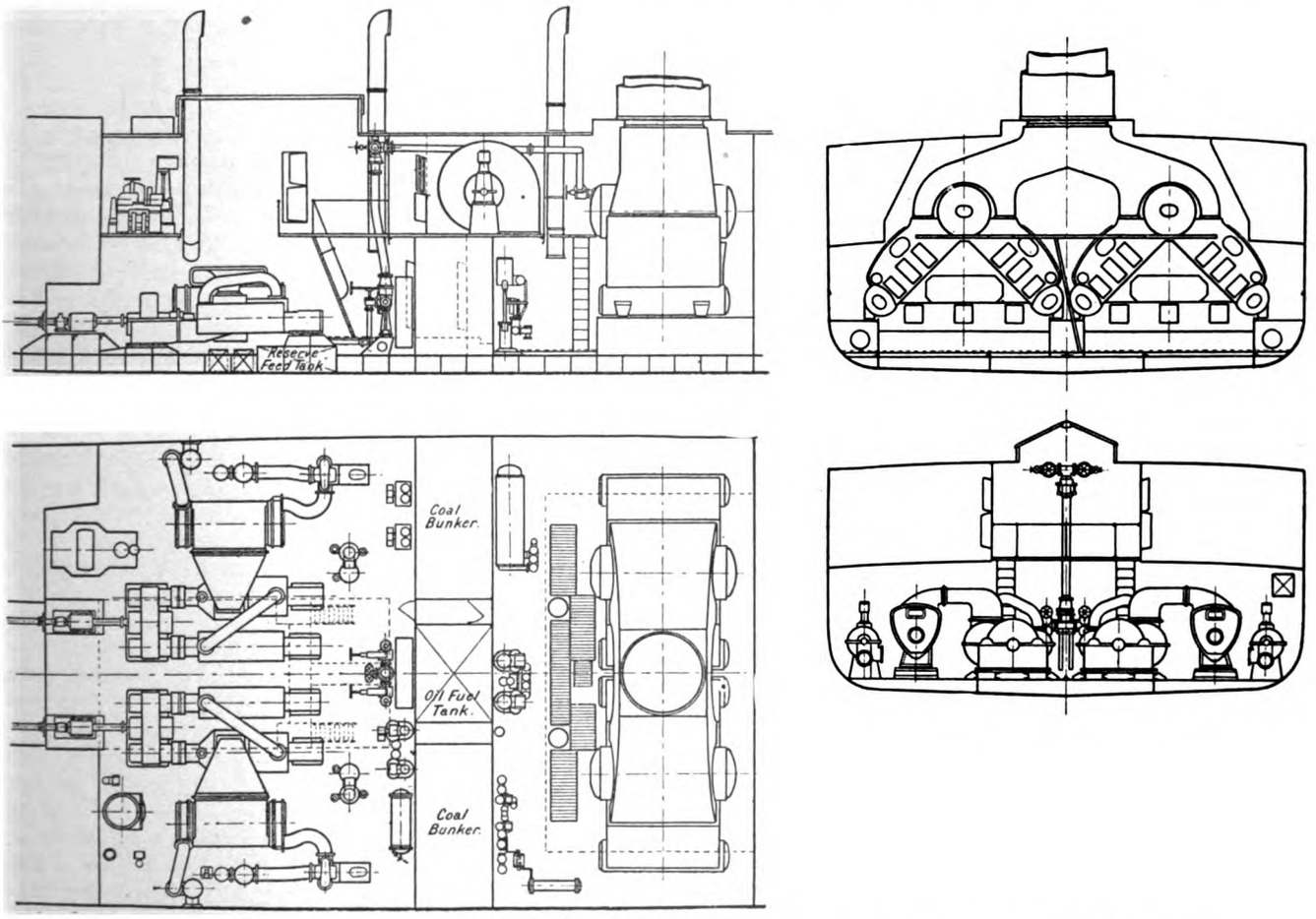
INBOARD PROFILE AND DECK PLAN OF TURBINE STEAMERS CURZON, HARDI NGE AND ELGIN

Three Steamers With Geared Turbines

A. & J. Inglis, Pointhouse, Glasgow, have just completed for the South Indian Railway Co. three steamers, the Curzon, the Hardinge and the Elgin, for service between the Indian mainland and the island of Ceylon. The distance to be run by the vessels is about that of the English channel, 20 miles, and the water to be navigated varies from 12 to 14 ft. in depth. Under the contract the vessels were to start from rest and cover the 20 nautical miles of their journey in about 72 minutes. On trial they made it in 65 minutes.

The propelling machinery consists of two sets of geared Parsons turbines—the first, we are informed, actually to be made in Scotland—driving twin screws. To each shaft a high pressure and a low pressure turbine are coupled by means of machine cut gearing which enables the turbines to be run at 3,500 revolutions per minute, while insuring an efficient low speed for the propellers. A high-powered astern turbine is embodied in each low pressure casing. Two Yarrow water tube boilers, specially designed for burning inferior qalities of coal are employed to generate steam. An oil burning installation of the pressure spraying type is fitted in each vessel for use in the future should occasion require it. The main feed pumps are automatically controlled, so that the water level in the boilers may be maintained constant.

The vessels have an overall length



ENGINE AND BOILER ROOMS OF THE GEARED TURBINE STEAMERS CURZON, HARDINGE AND ELGIN

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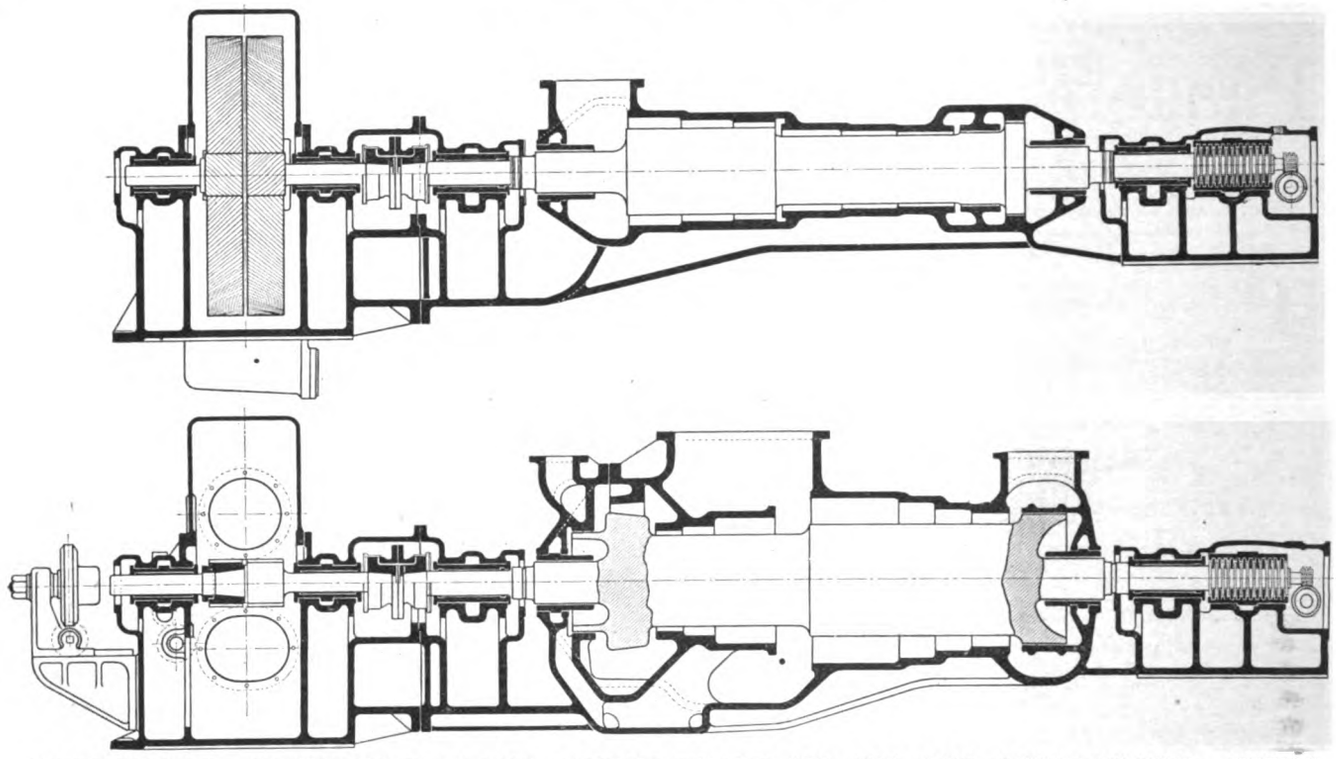
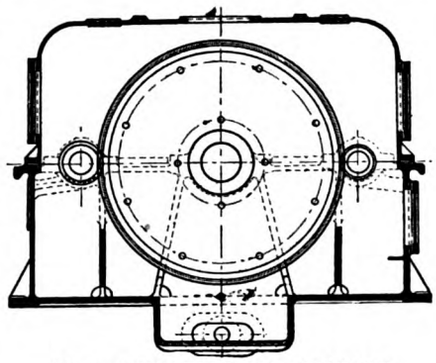


UPPER DIAGRAM: SECTION THROUGH HIGH PRESSURE TURBINE AND GEAR CASE. LOWER DIAGRAM: SECTION THROUGH LOW PRESSURE AHEAD AND ASTERN TURBINE AND GEAR CASE

of 260 ft., a breadth of 38 ft., and a depth to the promenade deck of 18 ft. 9 in. Their gross tonnage is about 700. They are provided with bow and stern rudders, controlled by steam steering year.

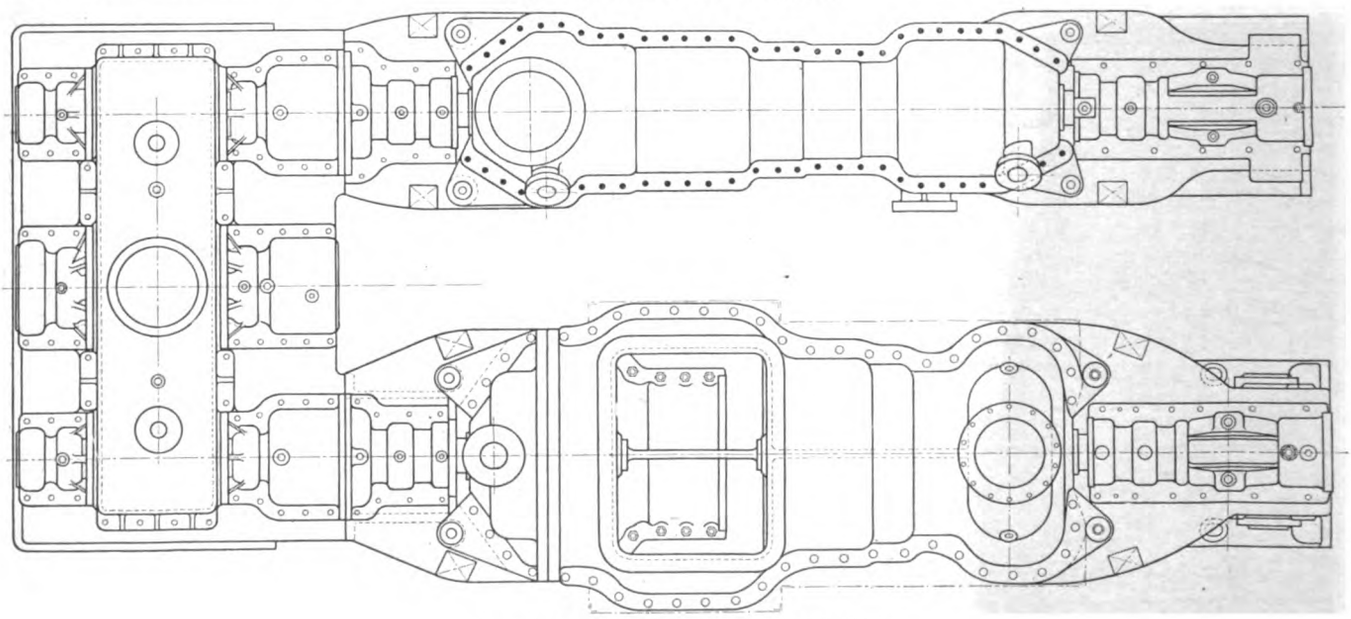
Extensions to Coast Shipyards

A number of Atlantic coast shipyards are making extensive additions to their plants. Cramps, Philadelphia, have made a number of additions during the past year and are understood now to be negotiating a loan in excess of $1,000,000 for further extensions. Large expenditures have also been made at the plant of the Harlan & Hollingsworth Corporation, Wilmington, Del., which will enable this yard to build vessels up to 520 ft. in length. The present capacity of the yard is a 350-foot vessel. The improvements will require the entire remodeling of the present launching slips, the installation of modern tracks and gantries for cranes, which will be electrically operated.



END ELEVATION OF GEARING

Representative Edmonds, of Pennsylvania, has introduced a bill in the house of representatives directing the president to construct or acquire 20 steamships of 8,000 tons each to be used as transports in time of war. An appropriation of $25,000,000 is asked for.



PLAN OF TURBINES AND GEAR CASE

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Passenger Steamer North American

This New Vessel Will Open Up a New Field and is Designed Exclusively for Passenger Service

THE steamer North American, the latest addition to the passenger fleet of the Great Lakes, has been completed by the Great Lakes Engineering Works of Detroit, Mich., and delivered to her owners. The vessel is somewhat different from the usual type of passenger steamers in that she is designed especially for carrying passengers only.

The ship is built of steel on the transverse system and the principal dimensions are: Length over all, 284 ft.; length on keel, 259 ft.; beam, moulded, 47 ft.; and moulded depth to main deck, 17 ft. 6 in.

The propelling machinery consists of a vertical four-crank, quadruple-expansion engine with cylinders 17½, 25, 36, and 52-in. diameter and 36-in. stroke, driving a four-bladed sectional propeller 11 ft. 7-in. diameter and 12 ft. 6-in. pitch. Steam is furnished at 210 lbs. working pressure by three Scotch marine boilers, each 12 ft. 6 in. mean diameter by 11 ft. 6 in. long, with 5,772 sq. ft. of heating surface. The speed maintained will be about 18 miles per hour. The auxiliary equipment is most complete with the usual bilge, sanitary, feed and fresh water pumps installed and the electric lighting plant is in duplicate and consists of two 35 K. W. turbine marine type generators. She is also equipped with a 7-ton capacity refrigerating plant located in hold.

On entering the large vestibule or social hall on the main deck, the passenger finds the purser's office, wireless operator's room, and barber shop at the after side of the hall, with the occupant's quarters conveniently adjoining their offices, and on the forward side is the steward's office and parcel or package room. The smoking room and bar is reached from vestibule by a wide, easy stairway, as it is directly under the social hall. The bar with its fixtures will be equal in appointments to that of any first-class hotel.

The Social Hall

On ascending the grand stairway the cabin deck is reached, on which are located 112 state rooms with 224 berths. On the after end of this deck is the ladies' cabin, with large easy chairs and lounges comfortably and richly upholstered, and on the forward part of the deck is an easy-grade wide stairway leading down to lower cabin deck, on which are located twelve state rooms with 48 berths; directly off this cabin and on the same deck the galley is located, arranged and built to take care of a large number of passengers expeditiously and satisfactorily; the dining saloon is on the orlop deck forward and extends across the full width of vessel by about 85 ft. long, with accommodations for 250 at one sitting, and is finished in a combination of Hindoo and Chinese color style. It will have a hardwood floor and be fitted for dancing parties. The total state room capacity is 524.

Upper Deck Arrangements

On the promenade deck are fifty-two state rooms with 104 berths, and twelve parlor state roams, which are furnished for three or four people and are all richly furnished and harmoniously decorated. These rooms are well lighted and ventilated, in fact provision has been made for daylight and fresh air in every state room on the boat.

Another feature which will appeal to the passengers is the closed balcony inside of cabin, which extends the full length of the grand saloon.

On the boat's deck are sixty state rooms with 120 berths, and four parlor state rooms fitted with brass framed beds.

Writing desks with all materials for correspondence are to be found in quiet, convenient corners on all decks, and on the outside in various places, and on the promenade are ice water drinking fountains.

Hot and cold water is installed as part of plumbing in every room on the boat; the vessel will be lighted throughout with 1,600 Mazda lamps of 20 candle power and equipped with a powerful 5,000 candle power searchlight projector; electric call bell service is provided from each state room with annunciator in the social hall.

On the main deck and away from the passenger entrance, are located the engineer's and oiler's rooms, and rooms for stokers, chef, cooks, porters, bartenders, waiters, cabin watchmen, etc., and aft over counter of the stern are gentlemen's toilet rooms. The captain's room occupies the space forward on the starboard side of upper cabin on the boat's deck, and is comfortably and suitably furnished. The pilot house and chart room is above the boat's deck; being so well aloft, the pilot house is away from the deck on which the passengers congregate, and this precludes the possibility of shutting off the pilot's view ahead. He thus has a much better outlook and is free from the pernicious influences of flickering lights at night, often encountered when on the deck below.

One very marked improvement over many other vessels is the complete arrangements made on a large scale for life saving appliances. On the boat's deck (so-called because it is reserved for lifeboats and life rafts) there are ten large lifeboats, built after the most approved regulations and set in chocks under properly fitted davits with approved appliances for hoisting and lowering. These boats have a capacity for 200 persons. In addition to this equipment there are thirty modern life rafts built for fifteen persons each, or a total of 450. Thus there are life boats and rafts of the latest type for the care of 650 persons, and life jackets, floats, etc., are in addition provided for about twice that number.

The vessel was built from her builders' plans, prepared under instructions of R. C. Davis, president and general manager of Chicago, Duluth & Georgian Bay Transit Co. W. J. Wood, naval architect, of Chicago, was retained to approve and pass on the plans and represent the owners on inspection during construction. Adolph Zietsch was local resident inspector during construction and will be chief engineer of the boat when she goes in commission. He was formerly chief engineer on the Goodrich Line steamer Alabama. The new boat will be taken out and commanded by Capt. A. E. Johnson, of Chicago. She will operate between Chicago, Duluth and Georgian Bay ports in exclusively excursion service.

The interior decorations are in some respects quite unique and a radical departure from the ordinary practice on Great Lakes passenger steamers. This work was done by the William F. Goodrich Co., of Detroit, who to a great extent worked under the direction and suggestions of Mr. Davis, the managing owner of the boat.

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Russian Training Ship

The Grand Duchess Maria Has Undergone Extensive Remodeling in an English Yard

SWAN, Hunter & Wigham Richardson, Ltd., have just completed at their Wallsend shipyard, Newcastle-upon-Tyne, England, extensive repairs and alterations to this finely modelled three-masted iron ship. The Velikaya Knyashna Maria Nikolaevna, or in other words the Grand Duchess Maria, is called after one of the daughters of the Tsar of Russia. The ship was built by Messrs. R. Steele & Co. of Greenock, in 1873 She was called the Hesperus, owned by Messrs. Devitt & Moore, of London. She was famous for the rapid pas-

SAILING SHIP FOR TRAINING CADETS FOR THE RUSSIAN MARINE

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sages she made between the United Kingdom and Australia, carrying passengers and cargo. The leading dimensions of the ship are 263 ft. long, 39½ ft. broad, with a depth of 23½ ft. Her gross tonnage is 1,925. Some twelve or fourteen years ago she was purchased by the Russian government to be used as a ship for training boys to become seamen in the merchant service and the vessel was placed under the control of the board of trustees of the Odessa School of Navigation. At present the ship is under the management of the Russian Volunteer Fleet Association of St. Petersburg. The alterations and repairs effected by Messrs. Swan, Hunter & Wigham Richardson, at Wallsend, included re-entry into Lloyds classification. The whole of the weather decks from stem to stern and also the 'tween decks were stripped and entirely renewed.

The complicated rigging of the vessel has also been renewed. Several new spars and yards on the fore and main masts have been provided and also a complete set of new yards on the mizzen masts. The ceiling in all the holds has been replaced by new timber. A new iron deck house has been built at the forward end of the ship and a new teak deck house on the poop. The steel top-gallant bulwarks have been made good and new teak rails added. An entirely new set of boats has been supplied. The steam windlass, capstan and winches have been renewed and an additional donkey installed. A deep tank, with a capacity of 1,000 tons of water, has been put into the ship, fitted with suitable pumping machinery for rapid discharge. This tank is also designed to hold cargo when required. In the 'tween decks accommodation has been made for 240 cadets and 35 seamen. Captain Balk, the commander of the vessel, is quartered in very commodious apartments in the poop, which is 74 ft. long.

Adjoining the saloon are a luxurious sitting room and a reception room. In addition to the captain's quarters in the poop there are cabins for the four officers, six instructors, and two doctors. The petty officers are quartered in the forecastle. The engineers and doctors' assistants have their apartments in the forward deck-house. An installation of electric light and steam heating has been fitted throughout the ship. Refrigerating machinery and cold storage rooms have been provided as an addition to the commissariat department. Carefully-designed fire-extinguishing apparatus has been put into the ship, and to complete the needs of modern times wireless telegraphic apparatus has also been installed, so that the Velikaya Knyashna Maria Nikolaevna may truly be said to be fully equipped in every detail for the service she undertakes.

Chilean Submarine Launched

The Chilean submarine Iquique was launched at the plant of the Seattle Construction & Dry Dock Co., her builders, at Seattle, Wash., on June 3. The double ceremony attending the launching was unusual and interesting. Before the breaking of the bottle of wine on the bow of the new vessel, the Rev. Fr. David J. Hanly, of St. James Cathedral, Seattle, dressed in ecclesiastical robes, blessed the vessel in accordance with a Chilean custom at all launchings of war craft for that South American republic. The Iquique was christened by Senora Maria Larrain de von Schroeders, wife of Lieut. Edgar de von Schroeders, who is to be the first commander of this under water fighter. Attending the ceremonies were officers of the Chilean navy and members of that republic's naval commission, who had been in Seattle watching the progress of construction on the boat, representatives of Pacific Coast shipbuilding and transportation companies and many socially prominent guests. As she slid down the ways the Iquique flew Chilean and American flags.

After her launching, the guests repaired to the offices of the Seattle Construction & Dry Dock Co. and toasts were drunk to the vessel and her sponsor and speeches of felicitation closed the ceremonies.

The Iquique was built at the plant of the Seattle Construction & Dry Dock Co. under the supervision of the Electric Boat Co., of which T. S. Bailey is Pacific Coast manager and G. H. Eggleston constructing engineer. A sister submarine for the Chilean government, the Antofagasta, which is now building at the Seattle plant, will be launched in August. The Iquique, as well as the Antofagasta, will be delivered to the Chilean government at Valparaiso, to which port she will be towed from Seattle under the direction of the Electric Boat Co. The crew for the Iquique was in Seattle at the time of launching and was instructed in her operation during the builders' trial trips.

Sialia, the steam yacht, building for J. K. Stewart, of Chicago, was launched from the yard of the Pusey & Jones Co., Wilmington, Del., last week. The general dimensions of the yacht are: Length over all, 202 ft. 7 in.; length on water line, 26 ft. 6 in.; depth 17 ft. 6 in.

Cramps Annual Report

At the annual meeting of the William Cramp & Sons Ship & Engine Building Co., retiring officers and directors were re-elected. No one was elected to the board of directors to fill the vacancy caused by the death of Charles H. Cramp. The report for the fiscal year ending April 30, 1913, which was presented at the meeting, shows:

	1913.	1912.	1911.
*Net profits	$561,796	$473,021	$283,507
Fixed charges	255,119	264,913	277,339
Surplus for year	306,676	208,107	6,167

*Insurance and taxes deducted.

The company made the following payments: In reduction of capital debt $220,000 for 220 20-year 5 per cent serial notes redeemed and $25,000 for 25 first mortgage 5 per cent bonds redeemed; for purchase of real estate, new tools, machinery and improvements, $630,337.

In his annual report to stockholders, President Henry S. Grove says:

"To economically handle the business now on the company's books, the immediate purchase of a small amount of real estate and new tools, and the construction of new building and yard tracks, was necessary, and has been proceeded with. These improvements will be completed for about $150,000. Further extensions and improvements can be made as the need therefor develops.

"A new I. P. Morris machine shop and improvements in the I. P. Morris foundry were authorized a year ago and are practically completed. Within the last ten years the business of this branch of the company has increased threefold.

"The above branches of the company's business require no extraordinary expenditures. Their business and the profits from operations are increasing and promise to continue to do so.

"A summary of improvements is as follows: For new I. P. Morris machine shop and extension of I. P. Morris iron foundry, $600,000; for immediate improvements to shipyard, $150,000; total, $750,000.

T. L. Durocher, Marquette, Mich., was the lowest bidder for furnishing and placing rubble stone foundation for breakwater extension at Marquette at $22,880.

Wanless & King, Duluth, Minn., was the lowest bidder for placing rock on Ashland breakwater at $2.10 per ton. The sum of $20,000 is available for this work.

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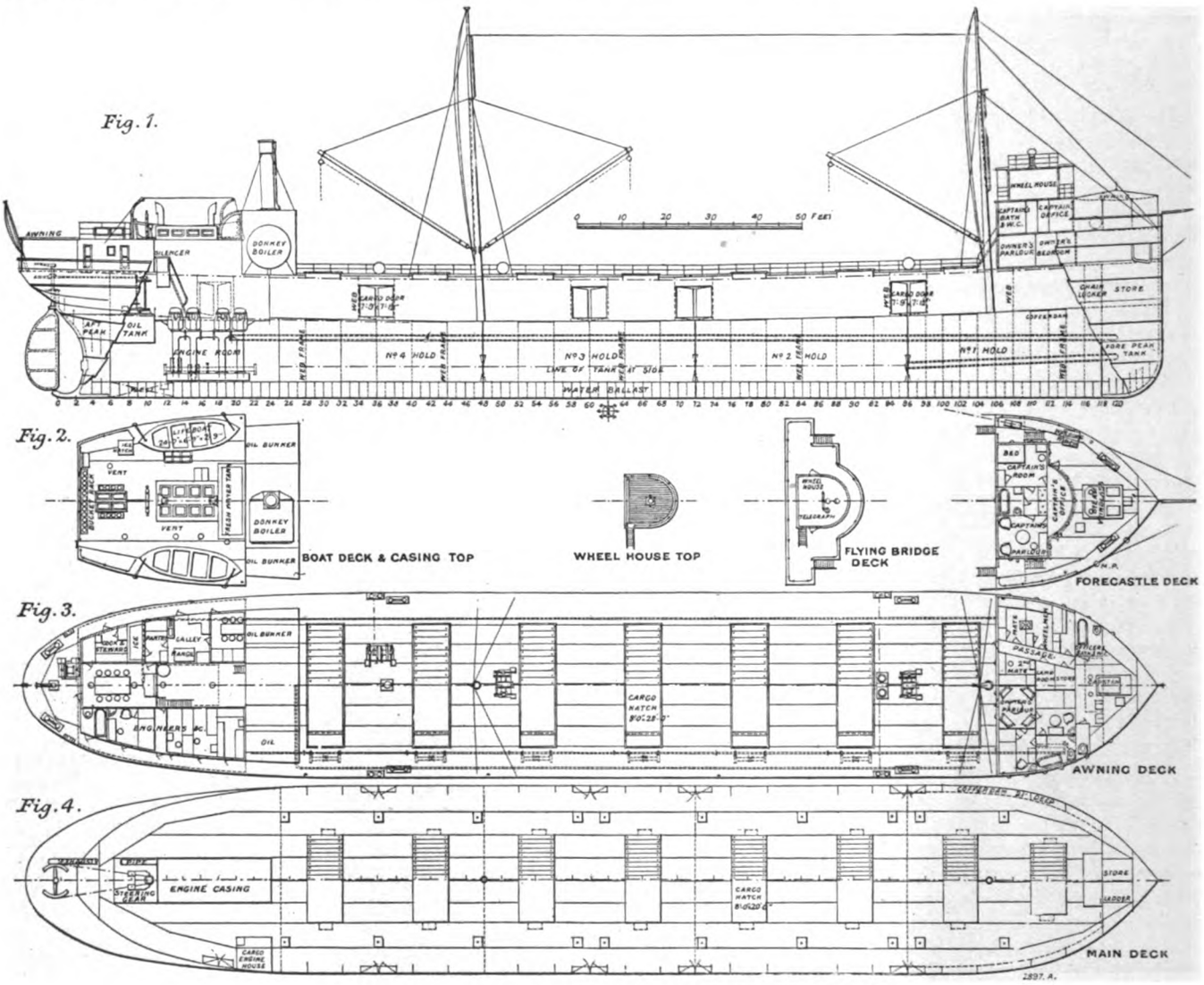
Motor-Driven Ship Fordonian

The Latest Example of a Diesel-Engined Vessel to Reach the Great Lakes

THE motor-power ship Fordonian, which was built by the Clyde Ship Building & Engineering Co., Port Glasgow, Scotland, for the Merchants' Mutual Line, Toronto, is now in service on the Great Lakes. She made the trip across from Port Glasgow to Sydney in 17 days, 21 hours, a total distance of 2,300 miles. The engine developed nominally 800 I. H. P., at 97 revolutions and the daily fuel consumption of oil was 3½ tons.

The leading dimensions of the ship are 250 ft. long, 42 ft. 6 in. beam, 16 ft. 10 in. molded depth to the main deck, and 26 ft. 6 in. to the awning deck. The Fordonian has a 2-ft. frame pitch, and a deadweight cargo carrying capacity of 3,300 tons on 16 ft. 6 in. draught. The draught on service is restricted to 14 ft. and the deadweight capacity is thus reduced to 2,200 tons. The vessel conforms to the standards of Canadian lake practice in that she has a steering-pole out forward to make quite handy the control from the forward bridge (Figs. 1 and 2), a large number of hatches (Figs. 3 and 4), and inward opening cargo doors on the port and starboard sides (Fig. 1), to facilitate the rapid removal of cargo. The cofferdam at the forward end of the fore hold is unusual in such vessels, and is intended to preserve the cargo from damage should the ship spring a leak as a result of coming in contact with any one of the many locks through which she passes in her regular trading. There are two independent controls from the bridge to the engine-room telegraph, and the steam steering engine is operated by rods from the bridge.

As with sister ships, there are two masts with derricks on each (Fig. 1), and the chart house and navigating bridge are situated right forward (Fig. 1). The rudder is balanced and is of large area. In the trials the vessel turned almost in her own length and when the helm was put hard over she almost came to a dead stop. The accommodation will readily be understood from reference to the plans (Figs. 2 and 3).



INBOARD PROFILE AND DECK PLANS OF FORDONIAN

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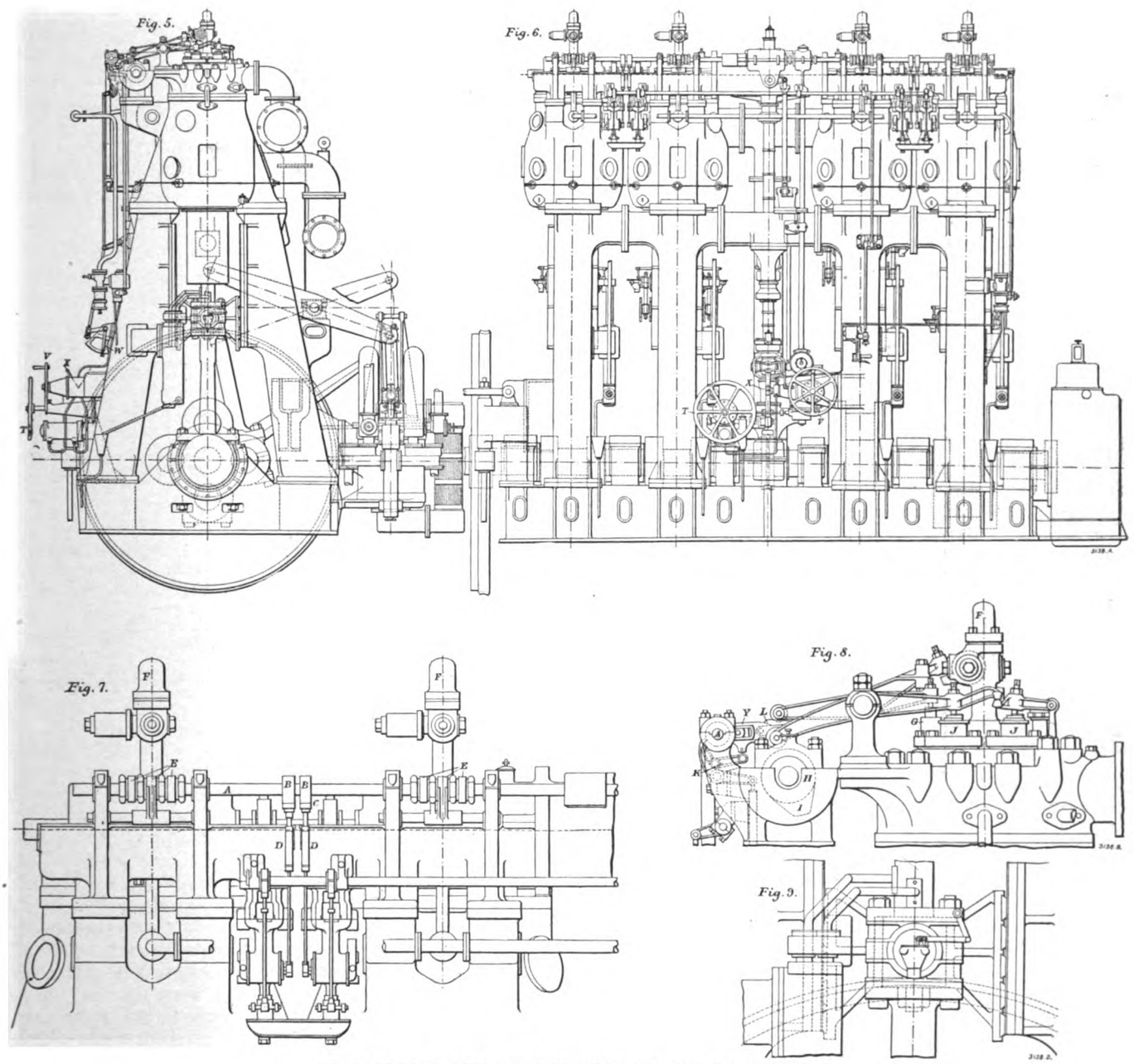
The propeller is 11 ft. 9 in. in diameter by 9 ft. pitch.

The main propelling engine is a four-cylinder two-stroke cycle single-acting Carels type of Diesel oil-engine. The cylinder dimensions are 460 mm. (18.1 in.) diameter by 820 mm. (32.25 in.) stroke, and the engine runs normally at about 100 revolutions per minute. These engines are illustrated in Figs. 5 to 9, and it will be seen that in the main features of the structure, steam-engine marine practice has been closely followed. The bed-plate is of cast iron and is of the usual marine design, having a flat bottom and being supported in the center as well as at the sides. This design contrasts with that evolved by many Continental makers, who prefer the bed-plate supported at the sides only, with the cross-members of deep box section carrying the main bearings, which have forced lubrication. This last method has advantages, but, as will be described later, the Fordonian has not a forced system of lubrication. The columns of the engine are of the usual box section, bolted rigidly together at the top, and are very thick, to withstand the tension stresses consequent upon the high pressures of the Diesel cycle. These tend to give great rigidity; the engine ran entirely free from vibration. With this design of support the bed-plate must be strong to take the bending stresses between the column feet and the main bearings.

The cylinders have separate liners pressed in, and the liners have exhaust-ports round the whole of their periphery, and communicate with an exhaust-belt of large cross-sectional area running round the cylinder. The water spaces are large, as the elevation of the cylinder shows, and ribs are cast on the inside of the cylinder to aid water circulation and to give to the cylinder-wall strength to resist the direct pull passing through it. On each cylinder there are six bolted doors, of about 9 in. diameter, permitting of ready inspection and cleaning of the water-cooling spaces. At the bottom of the cylinder there is a lantern-ring, which serves to keep the joint between the cylinder and liner water-tight, and, further, to prevent the escape of cylinder gases into the engine-room, which would be a serious drawback with an



SECTIONAL VIEWS OF THE FORDONIAN'S MACHINERY

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open engine. Any leakage of gases goes into an annular chamber, which is connected to the scavenging pump suction, and is thus kept at a pressure below that of the atmosphere. This means is efficient to insure an engine-room free from gases, although necessitating a long piston. The cylinder-head is of cast steel, to gain the necessary strength, and has large cooling water spaces, with seven valve-openings; one fuel, four scavenging, one starting air, and one safety. It is probable that at an early date such covers will be made of cast iron.

The piston of the Carels engine is in two pieces. The top piece is carried by a shoulder on the piston-rod, and the bottom piece, or shroud, is carried at its bottom by another shoulder, on the piston-rod. The forming of the piston in two pieces makes for simple castings, and when the high temperatures are considered, this is a desirable end. Water cooling is adopted for the piston, and the water is circulated by the action of the plungers, as shown, as opposed to the system of walking pipes. The piston in this engine ran cool on trial, and the stresses due to temperature would thereby be minimized. Moreover, this advantage makes it possible to reduce clearances, consequent upon the large expansions due to the high temperature, and there is thus less chance of losing compression.

Scavenging Pumps

The arangement of the engine into two units of two cylinders each permits of a two-piece crank-shaft in interchangeable halves, of the vertical spiral drive for the valve gear being taken from the center of the engine, and also of the scavenging pumps being driven from the two center crossheads by links, as with the air-pump of steam engines. The dimensions of the double-acting scavenging air-pumps are 27¼ in. in diameter with a 23½-in. stroke, and give thus a ratio of free air compressed for scavenging to combustion air taken into the main cylinders of 1.65, which is higher than the usual practice. The pressure of the scavenging air is 3 lb. per sq. in. There are four valves in the cylinder-head for the inlet of the scavenging air to cope with the large volume of low-pressure air used in the engine. This combination of large volume of scavenging air, a large reservoir, and four valves in the cylinder-head, makes for good combustion and a clean exhaust. The scavenging pumps are controlled by two piston-valves worked by slipping eccentrics driven from the aft part of the two-piece interchangeable built-up crank-shaft, and the change of angular position permitted by the slipping of the eccentric on the crank-shaft automatically reverses the scavenging pump piston-valves. The scavenging air is led by cast iron pipes from the valves to a built-up 3-16-in. lap-riveted steel-plate reservoir running along the cylinder top and supplying the four scavenging valves on each cylinder.

The exhaust is led down by bent cast-iron pipes from the cylinder-belt to the main exhaust-pipe running along the engine to the water injection, and the silencer is also internally water-cooled and is of the cascade design. This very effectively silences the exhaust, but it is difficult to judge the combustion of the engine at the overboard exhaust, since the water must cleanse unburnt products. The exhaust is led overboard under the counter. The funnel is for the exhaust gases from the donkey boiler.

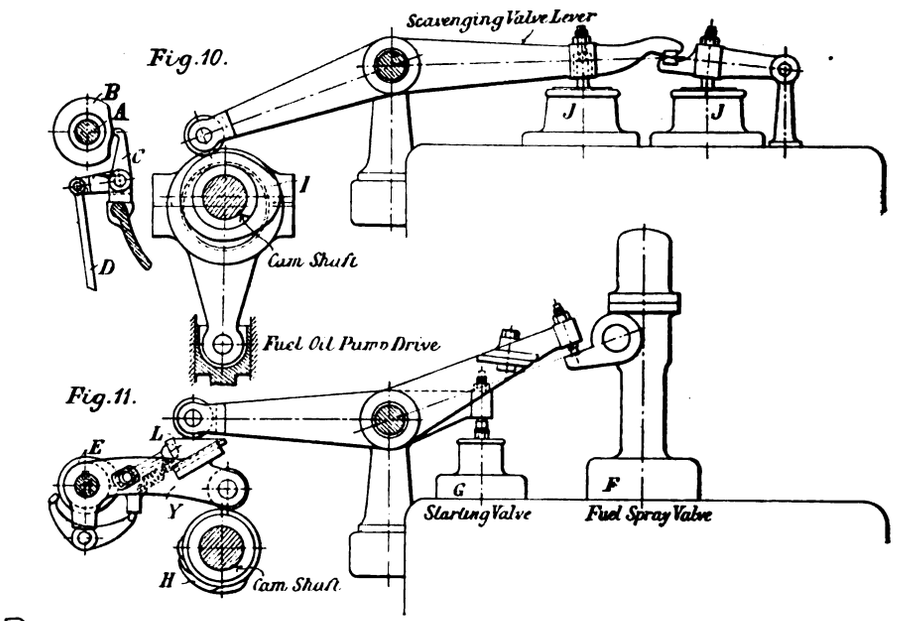
Separate leads are provided from the water-cooling pumps worked off the links driving the scavenging pumps, and cocks are provided on all these leads to regulate independently the amount of cooling water supplied to each part. The temperature of this cooling water may be felt, as there are open discharges into funnels leading to the bilges. These open discharges can clearly be seen, besides the engine columns, in Fig. 6.

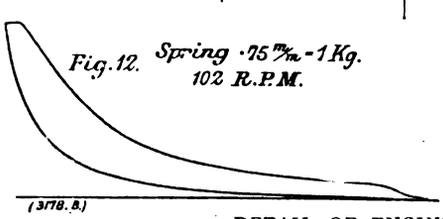
The crank shaft is built up, since the large stroke bore ratio permits of this construction, and the connecting rod is standard marine practice.

The system of lubrication is interesting. For the main bearings solidified oil is used, for the crank pin bearings the ordinary drip-feed suffices, and the bearing pressures for the main and crank-pin bearings are respectively about 300 lb. and 650 lb. per sq. in. For the lubrication of the cross-head bearing, a small lubricating oil forcing pump is attached to each crosshead, and worked by the swing of each connecting rod, as shown. This system of lubrication permits of an open crank case, and the bottom end bearings can always be easily felt by the engineer on watch. There are two guides for each, such being Messrs. Carels' practice for oil engines. The piston is lubricated by four Mollerup lubricators, which force the oil between the piston and the cylinder; there are four inlets to the cylinder, and they are arranged to enter on the fore and aft and athwartship center lines.

As already enumerated, there are seven valves and an indicator cock in the cylinder covers. These valves are operated in the usual way by cams and cam levers. The fuel valve has a rotary, and not a reciprocating, gland; this makes for tightness. The levers are of cast steel. The cams are of hardened cast iron, and the cam shaft is driven from the crank shaft, as seen in Fig. 6, by a helical gearing through a vertical shaft, with cast iron helical wheels and pinions.

Reference to Figs. 10 and 11, on the next page, diagrammatical sketches of the valve gear, will make the valve





DETAIL OF ENGINES OF FORDONIAN

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gear and the reversing and maneuvering mechanism quite clear. There are two shafts running fore and aft at the cylinder tops, and supported by brackets to the cylinder body in the usual way. The outer shaft A is the maneuvering shaft, and to it are keyed, firstly, cams B for operating the fuel pumps, suction valves by means of the bell-crank lever C and rod D, as seen in Fig. 10, and, secondly, the cams E (Fig. 11) which serve to regulate the amount of lift of the fuel and starting air valves F and G respectively, and also to lift and replace the interstarting and interfuel levers from off the main cams H. Loose upon this shaft are two interstarting and interfuel levers Y for each cylinder.

Reversing Mechanism

Turning now to a consideration of the reversing mechanism and its operation, there are two scavenging cams I operating the four scavenging valves J, and these are reversed by turning the cam shaft through approximately 30 deg. by extending the driving vertical shaft by means of a compressed air servo-motor. It must clearly be understood that the scavenging cams do not move fore and aft. There are two fuel cams and two starting air cams to each cylinder, and the cams E, by means of the roller raising lever, lift the interstarting and interfuel lever Y from off the cam upon which it has been working. Then the maneuvering shaft is moved longitudinally, and the interstarting and interfuel lever is brought into line with the fuel or starting air cam for the required direction of rotation. Further rotation of the maneuvering shaft rotating cams E—the interstarting and the interfuel valve levers are loose upon the shaft—causes the interfuel and interstatring air levers, of bronze, to descend upon the requisite cam. Still further rotation of the maneuvering shaft and its cams E actuates the wedge-piece L through a roller and spindle, and so first causes the opening of the starting air valve. Starting air is thus admitted to all four cylinders, and then for two cylinders a rotation of the maneuvering shaft cams, actuating now the wedge piece L, causes the starting air to be gradually cut out and the fuel to be gradually cut in.

Fuel Pumps

The fuel pumps, of which there are four—one for each cylinder—are operated by eccentrics from the cam shaft, and at the same time as the fuel oil is being cut into the first two cylinders the cams shown at B operate through bell-crank levers, and so control the suction valves of the fuel pumps, and fuel oil is thus delivered to the cylinder. After the two cylinders are firing the further rotation of the maneuvering shaft causes exactly the same cycle for the other two cylinders, and all cylinders will then be running on fuel.

The working of the valve-gear, the exact relationship betwen the cam shaft, maneuvering shaft and cam levers, can well be understood from reference to the drawings published. The action of the wedge piece is obvious, and the spring which controls it is shown. It will be noticed that the fuel and starting air cam levers are in two pieces, to facilitate the inspection of the valves. The scavenging air valve gear is also clearly shown, and the manner in which the four scavenging valves are operated will be readily understood.

The feature about this interesting valve-gear is the wedging action whereby the starting air is gradually cut out and the fuel oil gradually cut in. This gives an even turning moment all the time. At the commencement the air pressure, 800 lb. to 1,000 lb. per sq. in., insures that there is a large starting torque; further, the design of the starting valve mechanism necessarily gives that large starting torque at all positions of the cranks, and the wedge action makes for an even turning moment throughout the period of engine acceleration. There is no shock due to the air being suddenly cut off and the fuel suddenly cut in. It is a gradual process, the one merging into the other.

Control of Engine

The control of the engine is by means of one wheel and two levers on the starting platform; one lever, X, Figs. 5 and 6, controls the compressed air engine, which gives the cam shaft its angular displacement by raising or lowering the vertical driving shaft, and also gives the maneuvering shaft its fore-and-aft movement. The other lever, W, Fig. 5, controls the fuel. The wheel V, Figs. 5 and 6, operated by hand, gives the maneuvering shaft its rotary motion. As seen in Figs. 10 and 11, the cams upon the maneuvering shaft act upon the suction valves of the fuel oil pump. Hand control is also provided by the handle on the column, which actuates a shaft running fore and aft on the engine, and so sets all the fuel pump suction valves. The small dial seen above the hand wheel (Fig. 6) indicates the position of the valve gear. Although compressed air is used, as stated, for actuating the vertical shaft, causing the angular rotation of the cam shaft and the rotation and displacement of the maneuvering shaft, hand gear, as shown in Figs. 5 and 6, in emergency may be used—viz., wheel T.

The description of the valve and maneuvering gear is of necessity long; at first sight the valve gear may appear complicated, but this is not the case. It is true that, compared with some designs, it is composed of many parts, but the function of each is simple and definite. This vessel on her regular route from Montreal to Fort Arthur must pass, each trip, through some 30 to 40 locks, and this demands maneuvering qualities far above the average, and that the engines must be capable of being stopped, started, and reversed in a very short time. Stopping from full speed ahead was on trial accomplished in two or three revolutions of the main engines, and reversals from full ahead to astern took six seconds. A trial of maneuvering was then made, and reversals were carried out from orders given from the bridge to correspond with the actual conditions in service of this vessel, 63 reversals were accomplished in 42 minutes, with more than half of the high pressure compressed air still unused. The auxiliary steam driven compressor was, of course, in use for the trial.

The system of having one fuel pump for each cylinder makes for easy regulation of the quantities of fuel oils supplied, and so permits of a very slow speed of revolution. On the trial trip forty-six revolutions per minute was the minimum attained; but when the final tuning-up has been accomplished, and all cylinders at all speeds are developing exactly the same power, a minimum speed of revolution of about thirty-five revolutions will no doubt be achieved.

No governor is fitted, as rough weather is not normally encountered, and the heavy fly wheel, some 9 ft. in diameter and about 7 tons in weight, is relied upon.

Three-Stage Compressor

The compressed air for the injection of the fuel oil into the working cylinders, and also for the starting of the engine, is supplied by a Reavell's marine type reversible three-stage compressor. The compressor is an integral part of the Diesel engine, and as such is rightly driven from the main engine. The Reavell compressor is bolted on to the bed plate at the forward end, and is driven by a pin off the crank shaft. The stroke is 8 in. (7¾ in. net), allowing for the ¼-in. auxiliary ports; and the diameters are: Two low-pressure cylinders, 15 in.; one intermediate cylinder, 9½ in.; and one high-pressure, 4¾ in. The volume of free air per minute dealt with by this compressor is 6,200 litres, and it was noted on trial that the air was supplied cool. This is an important point, as

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explosions have been put down to lubricating oil in suspension in the heated air. This compressor has multitubular intercoolers.

As well as the main compressor and the scavenging air pumps, the cooling water and bilge pumps are driven off the main engine. The cooling water and bilge pumps are driven off the scavenging air pump links in the same way that these pumps are driven off the links of the air pump with mercantile steam engines. The bilge pumps in this engine are of larger capacity than is usual, because, it will be remembered, the cooling water from the pistons and guides drains to the bilges, as well as any leakage occurring with the plungers for water piston cooling. The cooling water from the cylinders and cylinder covers is led to a trough placed high up in the engine room, at which trough all discharges are visible. From there the water goes overboard.

Auxiliaries Steam Driven

The auxiliaries are steam driven from a cylindrical donkey boiler, situated aft on the awning deck in the fore part of the engine casing. The boiler is fitted with the Wallsend Slipway & Engineering Company's oil burning gear. The boiler uses exactly the same kind of fuel as the main engines. The auxiliaries are: The dynamo, auxiliary compressor, ballast pump, oil fuel pumps, three winches, a windlass, and steering gear. The auxiliary steam driven compressor is of half the capacity of the main compressor, and runs normally at 300 revolutions per minute.

Air storage for starting purposes is provided by four welded steel bottles of 23⅝-in. diameter by 8 in. long, and that for fuel injection by one bottle, 1 ft. in diameter by 3 ft. long. The pressure of the fuel injection air and the starting air is 850 lb. per sq. in., and for slow running engines, such as this, this pressure is quite usual practice. The time taken by the auxiliary compressor to fill up the air storage provided is about one hour. The remainder of the auxiliaries are normal steam practice, and call for no special mention.

The weight of the main engine alone is about 100 tons, and if the auxiliaries are included, all ready for work, 150 tons is the weight of machinery aboard.

There is fuel storage in two oil tanks placed on both sides of the oil fired donkey boiler, as seen in Fig. 3, and two ready-use tanks are placed aft of the engine room, and are provided with steam heating coils, whilst the oil is filtered, on its way to the fuel pumps of the main engines, through 15-gallon filters in the engine room. In all 105 tons of oil fuel is carried, whereas with the sister steamships 250 tons of coal is required. The consumption per day for all purposes is 5 tons of oil fuel, against 14 tons of coal.

The fuel consumption of this engine is 0.47 lb. per brake horsepower per hour, and this is good practice for two-stroke cycle engines with the scavenging pump and air compressor driven off the main engine. An indicator card taken off this engine is reproduced in Fig. 12. An inspection of the diagram shows that combustion was good and that the bore stroke ratio adopted by Messrs. Carels, together with the main features of the scavenging design, insured an efficient and complete combustion. The pressure of compression is 490 lb. per sq. in. The fuel injection line shows a good adjustment of the fuel valve for the fuel used, which was Scotch shale oil. The mean effective pressure from this card is 90 lbs. per sq. in., and is the usual figure under normal conditions, without any attempt at forcing. The indicated horsepower at 102 revolutions per minute and 90 lbs. per sq. in. is 970; 10 knots were achieved with the engines doing 128 revolutions per minute. The maximum revolutions were 140, the normal about 102, and the minimum 46. The results will undoubtedly be improved upon when the engines are finally tuned up, as prior to the trial trip they had only been run in dock trials for twelve hours in all. This is exactly the same treatment as is given to steam engines.

General Arrangement of Engines

The general arrangement of the engines and auxiliaries is well thought out to give the greatest possible immunity from breakdown. This is a point of some importance with single screw ships propelled by a comparatively new prime mover.

The crank-shaft is in two interchangeable pieces, and there are two scavenging pumps of large capacity. The auxiliary air compressor is of half the capacity of the main compressor, and since the vertical shaft drive for the valve gear is in the center of the engine, should the compressor give out, one scavenging pump fail, or even the crankshaft break, the main engine will still develop more than half its normal power. This type of engine seems very suited to the propulsion of cargo boats, and the saving in space consequent upon the adoption of the Diesel engine for this ship is five frame spaces, aggregating 10 ft., some 33 per cent. of the machinery space. For the particulars of this article we are indebted to *Engineering*, London.

Internal Combustion Engine of 5,000 H. P.

During the last regular session of congress, an appropriation was made for two oil fuel carriers. The navy department, after thoroughly looking into the question and examining all the different types of large, heavy oil engines built in Europe, has just concluded a contract with the New London Ship & Engine Co. whereby that company will supply complete working plans for two large oil engines of the Nuremberg type. While the exact details in regard to the ship and her engines are not available, it is definitely known that there will be two engines, each of six cylinders and developing 2,500 H. P., making a total for the ship of 5,000 H. P.

Up to this time, the largest marine engine to be built in the United States is that for the submarine tender Fulton, for which the New London Ship & Engine Co. has a contract. The Fulton's engine will be of 1,000 H. P. Thus, it will be seen that in the selection of this type of engine for the Maumee, which is to be the name of the big tank ship for the navy, the government has taken a great stride.

The advantages of the Nuremberg oil engine for this purpose are numerous, both direct and indirect. The direct advantages are primarily in the nature of economy. The ship will be able to run with a crew very much smaller than if she used steam. She will be able to use for her own propulsive purposes the same kind of oil which she carries as cargo. For a given amount of fuel, she will be able to travel about three to four times as far as she would using steam. All of these advantages are so well known and there has been so much talk during the past two or three years, that it is needless to dwell further upon them at the present time. It is interesting to note, however, that these advantages are so well recognized, that there have been already built abroad over 75 vessels, exceeding 100 feet in length, which now use oil engines. Fifty-three other vessels are now building, some of them even larger than their predecessors, all using internal combustion engines of the Diesel type. The aggregate represents something like 100,000 H. P. now used for marine purposes in large ships.

The subject of large oil engines for naval vessels is a live one and has received the attention of all the principal European powers. Germany is experimenting with engines of 12,000 h. p. for battleships. France is doing likewise. England is building a number of large oil fuel carriers, equipped with these engines, but this is the largest ever built for a cargo ship.

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New Passenger Steamer Tacoma

The Fastest Vessel of the Fleet Now Operating Between Seattle and Tacoma

ASSERTED by her owner and builders to be the fastest single propeller steamship in the world, the new passenger steamer Tacoma has just been placed in commission between Seattle and Tacoma. All previous records over this course have been broken by the Tacoma which was designed especially for this traffic and bids fair to more than measure up to every requirement.

The Tacoma was built by the Seattle Construction & Dry Dock Co. for the Inland Navigation Co., which operates modern passenger and freight vessels to all parts of Puget Sound. This company in the last three years has had six steel passenger vessels constructed at the Seattle yard for its various Puget Sound routes but the crowning achievement is the Tacoma, whose great speed and luxurious accommodations will make her extremely popular with the very fastidious traveling public which numbers hundreds daily between the two principal cities of Puget Sound.

The distance between the two cities is 28 land miles. Heretofore the running schedule had been from 1 hour 40, to 1 hour 50 minutes. The Tacoma is said to have made the run in 1 hour, 10 minutes, so that the saving in time is of prime importance. The Tacoma can travel between the two ports in less time than the limited electric interurban trains can make the distance by land, 36 miles, so that the great competition between the water and land routes is likely to be decided in favor of the new daylight express steamer.

While the Tacoma is possibly a trifle in advance of the requirements of the traffic, her construction is in line with the policy of her owners to keep ahead of the demands of the public. By initiating service and constantly improving it, the Inland Navigation Co. has aided in building up many hitherto inaccessible parts of the Puget Sound territory. The Tacoma will not be rightly in her element until a sister vessel is constructed, as at present no other vessel on the Seattle-Tacoma route can equal her time, so that the schedule is uneven. The owners are already contemplating the ordering of another speedy vessel so that the two may operate alternately and on the same running time.

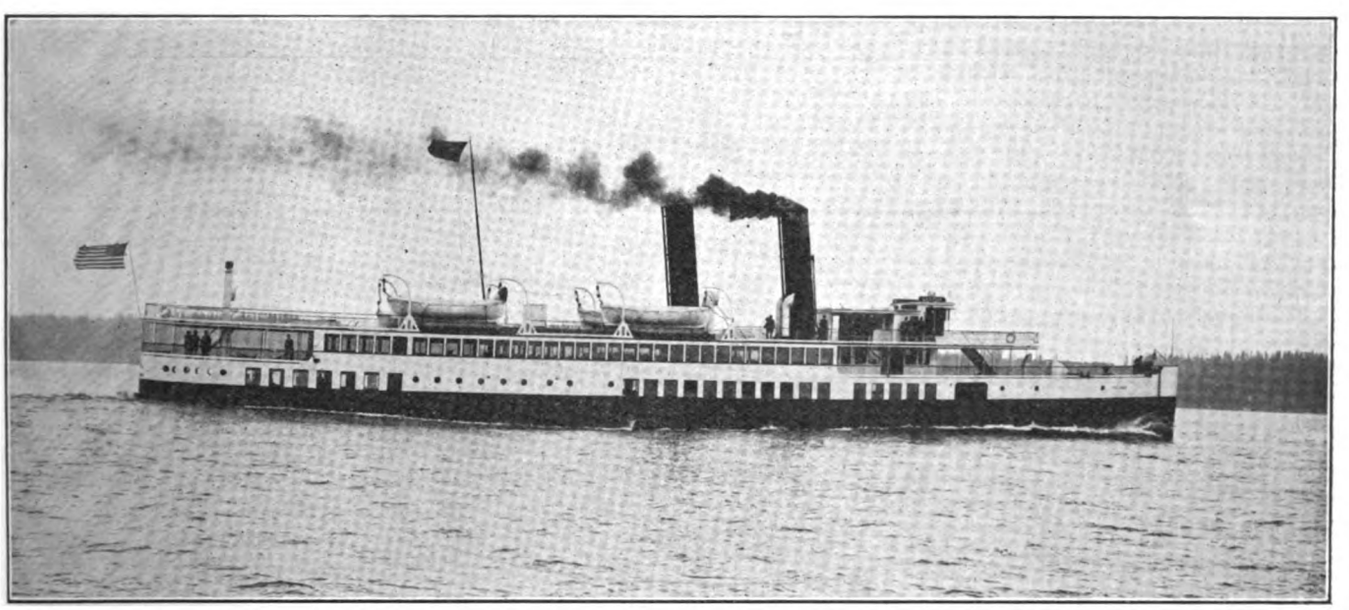
For the first time the water lines can now offer strenuous opposition to the interurban line but the rapid growth of travel between the two cities will tax the facilities of both. The fastest time made by any vessel between the two cities, prior to the advent of the Tacoma, was an exceptional run by the old steamer Flyer which several years ago did the distance in 1 hour, 29 minutes. On her trial the Tacoma cut this down to 1 hour, 10 minutes and she has since been making the course in from 1 hour 13 to 1 hour, 17 minutes.

The dimensions of the Tacoma are: Length over all, 221 ft.; length on water line, 218 ft.; breadth, 30 ft.; molded depth, 10 ft. to main deck. She is built of steel throughout, the steel sides being carried up to the uppermost or boat deck. She has a straight stem and a cruiser type of stern, one mast and two funnels, painted red to indicate the fleet.

Being designed exclusively for daylight passenger service, the vessel has no berths. She will be allowed to carry 1,500 passengers.

The passenger accomodations are beautifully finished and furnished. On the main deck aft is the dining room, containing eight tables and thirty-two chairs. The interior of the dining room on sides is paneled with cedar painted white enamel, and the ceiling over head is paneled with the same material painted flat white. Through the sides in the dining room are large windows in hardwood frames, about 4 ft. long and 3 ft. high.

Aft of the dining room is the pantry and galley, at the extreme end of the ship. Thus any disagreeable odors from cooking are left behind instead



STEAMER TACOMA OF THE INLAND NAVIGATION CO.'S FLEET

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of permeating through the passenger spaces.

Forward of the dining room is a lobby and stairway to the upper deck. On the starboard side at the foot of the stairway is the ladies' rest room, paneled on sides and top with white, and leading to the ladies' lavatory.

The main passenger space on the upper deck is finished in mahogany panels on the sides, and in fir composite board with mahogany mouldings overhead.

The sides and ends of this upper deck house are fitted with large windows about 30 in. wide and 36 in. high, and placed low down so that a person sitting in a chair can see out with no trouble whatever. This room is about 110 ft. long and the full width of the boat.

Aft on the upper deck is an open veranda with portable windows on the sides, the after end being entirely open.

The decks in passenger accommodations are covered with linoleum and fitted with carpet runners.

Forward on the main deck, with a stairway down from the upper deck is the smoking room. This is paneled on the sides with quartered oak and overhead with fir panels painted white. The smoking room is fitted with leather cushioned oak seats around the sides, oak bar in the corner and three hardwood card tables. The deck in smoking room is covered with paneled tiling.

The main stairways are of mahogany with mahogany rails and polished brass grille work.

The Tacoma is propelled by a four-cylinder, triple expansion engine, cylinder diameters, 23 in. x 36 in. x 42 in. x 42 in. by 30 in. stroke. The horsepower is 3,500. Steam is supplied by two large size Ballin water-tube boilers, fitted for burning oil fuel and with steam pressure of 250 lbs. In every respect the Tacoma is a credit to her builders and her owners, being equipped with all devices for safety, comfort and speed. The advent of the Tacoma illustrates the rapid advance made in travel between Puget Sound ports when the new vessel is compared with some of the slow craft operating in these waters but recently retired. At the builders' trial the Tacoma made a splendid record of 20.51 knots over the measured mile.

The fact that the Tacoma is at present operating alternately on the Tacoma-Seattle route with the passenger steamer Indianapolis, built at Toledo, in 1904 makes the advent of the new Puget Sound built steamer of additional interest to builders on the Great Lakes. The Inland Navigation Co. bought the Indianapolis in 1907 and brought her to the Pacific coast. For six years the Indianapolis has operated successively between the two ports, making four round trips a day and covering the 28 miles between Seattle and Tacoma on an average of 1 hour, 40 minutes. The Indianapolis could do better time but the schedule does not call for it. Although she cannot equal the speed of the Tacoma, the Indianapolis has many years of good service left in her and is not yet designed for the discard. The same company is also operating the steamers Chippewa and Iroquois, which were built at Toledo in 1900 and 1901 respectively. These vessels were brought around via Magellan and are engaged in routes between Tacoma and British Columbia. They have been very serviceable and are well known to every traveler by water in these parts. The Tacoma is longer than either of these three Great Lakes vessels, but is of different lines, being built more for speed.

Will Meet in December

The Society of Naval Architects and Marine Engineers which has hitherto held its meetings on the third Thursday and Friday of November, will hereafter hold them on the second Thursday and Friday in December. This has been done in order to accommodate the members from the great lakes region who have found it impossible to attend the meetings in the numbers desired owing to trade conditions existing in the closing weeks of the season's business. The council therefore has changed the time to a later date and it will of couse be helpful in this particular, though if full membership were needed from the lakes, the latter part of January would be the ideal time.

A company headed by J. J. Kane, manufacturer, is now being formed to construct a dry dock at Galveston.

SUMMARY OF NAVAL CONSTRUCTION.

Name of vessel.	Contractor.	Per cent of completion. June 1, 1913. Total.	June 1, 1913. Per cent on ship.	May 1, 1913. Total.	May 1, 1913. Per cent on ship.
BATTLESHIPS.					
New York	New York Navy Yard	79.7	78.4	77.2	75.0
Texas	Newport News Ship Building Co.	89.7	88.2	88.4	86.1
Nevada	Fore River Ship Building Co.	33.8	15.2	29.3	11.5
Oklahoma	New York Ship Building Co.	29.6	17.9	26.0	14.4
Pennsylvania	Newport News Ship Building Co.	0.8	0.5	00.0	00.0
DESTROYERS.					
Cassin	Bath Iron Works	90.6	90.5	87.2	87.1
Cummings	Bath Iron Works	87.3	87.2	81.2	81.1
Downes	New York Ship Building Co.	52.8	50.3	47.5	44.1
Duncan	Fore River Ship Building Co.	85.0	83.2	79.0	76.3
Aylwin	Wm. Cramp & Sons	94.3	93.8	92.1	91.2
Parker	Wm. Cramp & Sons	91.8	91.0	89.2	88.1
Benham	Wm. Cramp & Sons	90.1	89.5	87.9	86.8
Balch	Wm. Cramp & Sons	90.1	89.4	88.5	87.9
O'Brien	Wm. Cramp & Sons	1.8	0.8	1.3	0.8
Nicholson	Wm. Cramp & Sons	3.8	2.8	1.2	0.8
Winslow	Wm. Cramp & Sons	3.4	2.4	1.2	0.8
McDougal	Bath Iron Works	8.1	3.0	4.4	2.5
Cushing	Fore River Ship Building Co.	10.2	4.7	8.9	3.7
Ericsson	New York Ship Building Co.	6.5	2.5	5.0	1.9
SUBMARINES.					
F-4	Electric Boat Co. (Seattle)	Completed*			
G-4	American Laurenti Co. (Philadelphia)	88.4	87.5	88.4	87.5
G-2	Lake Tow Boat Co. (Bridgeport)	87.8	87.8	87.2	87.2
H-1	Electric Boat Co. (San Francisco)	92.2	91.6	90.4	90.1
H-2	Electric Boat Co. (San Francisco)	91.3	90.7	90.0	89.7
H-3	Electric Boat Co. (Seattle)	89.1	87.4	88.0	87.0
G-3	Lake Tow Boat Co. (Bridgeport)	68.1	66.9	67.4	66.0
K-1	Electric Boat Co. (Quincy)	78.3	75.9	76.6	74.3
K-2	Electric Boat Co. (Quincy)	78.8	76.5	76.8	74.4
K-3	Electric Boat Co. (San Francisco)	77.5	76.2	75.6	74.0
K-4	Electric Boat Co. (Seattle)	76.0	72.8	75.0	71.4
K-5	Electric Boat Co. (Quincy)	61.6	56.4	58.7	53.2
K-6	Electric Boat Co. (Quincy)	61.2	56.0	57.1	51.5
K-7	Electric Boat Co. (San Francisco)	67.4	65.4	65.3	63.3
K-8	Electric Boat Co. (San Francisco)	65.4	63.4	63.4	61.4
L-1	Electric Boat Co. (Quincy)	00.0	00.0	00.0	00.0
L-2	Electric Boat Co. (Quincy)	00.0	00.0	00.0	00.0
L-3	Electric Boat Co. (Quincy)	00.0	00.0	00.0	00.0
L-4	Electric Boat Co. (Quincy)	00.0	00.0	00.0	00.0
L-5	Lake Tow Boat Co. (Bridgeport)	00.0	00.0	00.0	00.0
L-6	Lake Tow Boat Co. (Long Beach, Cal.)	00.0	00.0	00.0	00.0
L-7	Lake Tow Boat Co. (Long Beach, Cal.)	00.0	00.0	00.0	00.0
M-1	Electric Boat Co. (Quincy)	00.0	00.0	00.0	00.0
SUBMARINE TENDERS.					
Fulton	New London S. & E. B. Co. (Quincy)	12.2	5.3	11.6	5.3
FUEL SHIPS.					
Proteus	Newport News Ship Building Co.	93.1	90.9	90.7	89.1
Nereus	Newport News Ship Building Co.	89.5	87.3	87.1	85.2
Jason	Maryland Steel Co.	99.5	99.5	98.8	98.8
Jupiter	Mare Island Navy Yard	99.1	99.1	99.1	99.1
Kanawha	Mare Island Navy Yard	00.0	00.0	00.0	00.0
Maumee	Mare Island Navy Yard	00.0	00.0	00.0	00.0
GUN BOATS					
Sacramento	Wm. Cramp & Sons	18.0	10.1	11.1	3.2
Monocacy	Mare Island Navy Yard	43.8	31.9	32.7	23.0
Palos	Mare Island Navy Yard	43.8	31.9	32.7	23.0

*F-4 delivered at Puget Sound Navy Yard, May 2, 1913.

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New Hamburg-American Liner

The Imperator, the World's Largest Steamship, is a Triumph in Ship Designing

THE Hamburg-American liner Imperator recently completed her maiden voyage across the Atlantic and was inspected by thousands at the port of New York. It will be recalled that the Titanic sank shortly before she was launched and caused steamship companies in general to revise their ideas concerning the safety of ships. The Imperator is sub-divided both transversally and longitudinally, and is really a ship within a ship. Like the Mauretania and Lustania, of the Cunard Line, the Imperator would have withstood the shock which sank the Titanic without serious danger. The point that strikes the layman in the Imperator is the complement of life boats. She actually has eighty-three, sufficient for 5,500 persons, or 300 more than she will ever carry, passengers and crew included. Only four of the life boats are fitted with blocks and manila falls; the rest are fitted with electric winches and wire ropes, and when once clear of the side can be lowered in 15 seconds.

The arrangement of the electric boat-lowering winches is due to the Welin Co., and reflects credit both on the designer and the builders. On the boat deck there is one electric motor for every three boats. This motor drives a 4-in. shaft carried in bearings on the deck close against the superstructure, so that it is not in the way, and from the shaft there are driven three winches, one for each boat. There is a pinion on the shaft and a wheel on the winch; this gearing is not toothed, but is of the frictional type introduced many years ago by Mr. Robertson, of Glasgow, there being several alternate V-shaped grooves and projections on each wheel. The projections of the pinions are, of course, pressed into the grooves in the wheel, and obtain a very firm frictional grip, which can be instantly released by moving the wheel forward.

Boat Lowering Device

There is, in addition, a frictional V fixed brake block, the whole arrangement being similar to the old Lancashire teagle, except that the frictional drive is by V's, and not by flat surfaces. The center spindle of the winch drum is mounted on an eccentric fitted with a powerful lever. When this lever is over one way the wheels are in gear; when it is over the other way the big wheel is in contact with the brake block, and intermediately the winch is free to rotate idly. A few inches movement of the lever commands all three positions. There are two wire ropes on the winch, and these are paid out and wound in simultaneously. One rope is led over pulleys to each davit, on which there is hung a two-sheave metal block.

Lifeboats on Two Decks

There is likewise a two-sheave block at each end of the boat, so that the craft is hung by four ropes at each end, and the strain on the rope, and consequently its diameter, is proportionately reduced. The tail end of each rope is not, as one might assume, made fast to an eye on the top block, for if it were, there would be no means of setting the boat horizontal if the ship were down by the head or the stern. This is a point of great importance, for it would evidently be a terrifying experience for passengers to be lowered 40 ft. in a boat tilted up at an angle of 20 degrees, while it would be courting disaster to drop a boat into the water at that inclination. The tail ends of the two ropes are therefore brought back from the davit ends, over sheaves to a small drum on the davit standard, on which they are wound in such a way that when the drum is rotated by a handle and worm-gear, one rope is wound up and the other paid out. Two or three turns of this drum will put a boat horizonal fore and aft, however great the inclination of the ship, and then she can be lowered with ease and celerity.

The life boats are fitted on two decks, "A" and "C," there being an unencumbered deck, "B," between them, which is kept free for the first-class pessengers, although there is also plenty of space on the decks which carry the boats, since these only occupy half the length. Evidently it would be inconvenient, to say the least, to have boats hanging one over the other when being lowered. It is a new feature to stow boats on intermediate decks, and has needed the introduction of new forms of davits, but there is an immense advantage in breaking up the crowd into sections, and also in keeping a part of the weight of the boats and gear at a lower level. This increase in top weight at the last moment by the multiplication of boats and gear has been one of the difficulties imposed on the naval architect. Of course, it can be met with safety, but not in the manner that would have been adopted if it had formed part of the original design. Still all the ingenuity in the world will not put a quart into a pint pot, and neither will it provide for hanging eighty-three big boats singly round the sides of a vessel which has at the same time to afford a pleasant cruise to hundreds of exigent passengers. The life boats have therefore been supplemented by two motor-boats and by a large number of collapsible boats, which are nested in piles of three on the top deck above "A," and on the main deck fore and aft of the superstructure. As these collapsible boats are not near the side, they cannot be lowered from davits, and other means have been adopted. On the forecastle and on the poop there is a mast, each mast being fitted with five heavy booms long enough to reach well over the ship's side, and around the mast there are five electric winches. All these booms can simultaneously lift boats from the piles, and, when they have been equipped and filled, can lower them to the water. Of course, such boats would need hand-controlled guy ropes to keep them steady during the descent, but many of them are comparatively near the water; at least, they are not so high as those on the boat deck.

Place for Every Passenger

While it is a comfort to a passenger to know that whatever happens there will be a place for him in a boat, yet this is only a *pis aller*, and a shipping company which gets a reputation for "happenings" will soon have no passengers to carry. The Hamburg-American Line have therefore, on the principle that prevention is better than cure, more than duplicated their safeguards against accidents by increasing their staff of officers. They have always been able to command the pick of the profes-

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sion in each grade, but now they have widened the grades, so that, in spite of the demands of the body for food and sleep, there will always be not only an officer on the bridge, but also a captain trained by years of responsibility to act on his own initiative without seeking the support, or fearing the criticism, of a superior. In addition to the commodore, the ship carries four captains who have commanded large steamers successfully, and one of these will always be on watch, while the fourth takes general control of the crew. There are, in addition, seven officers, each of whom carries a captain's "ticket," so that as far as vigilance and skill can guarantee immunity from accident there should be nothing to fear. There is also a 30,000-candle power searchlight on the foremast, but this is probably more serviceable for what the American drummer calls a "talking point" than for use.

The Social Hall and Restaurant

It will only be a matter of months, however, for the memory of the Titantic to become as misty as that of the City of Boston, while, in the meantime, the demands of passengers for luxurious surroundings will remain as clamant as ever, even if they do not become more so. The designers of the Imperator have kept this fact fully before them, and while exercising their skill to produce a safe ship, they have not abated their efforts to produce one which approaches as nearly to a modern palace as is possible. The time has long gone past for elaborating the point that the interior of a passenger ship has ceased to be nautical, and has become a splendid hotel, in which it is possible to live for a week without any reminder that one is not on dry land, unless a tempest of very exceptional violence should be encountered. In the trip from the Elbe to the Solent on Wednesday and Thursday of last week there was no indication to the passenger that he was at sea except a slight list to starboard—the result of the wind of half-gale intensity acting on the 600,000 sq. ft. of surface presented by the ship's side. When the wind subsided the sea and sky slid past, while the ship apparently stood still, although at times it was exceeding 23 knots, and an invitation to a game of billiards would not have appeared incongruous. This, of course, was in the Channel, and the Imperator has yet to demonstrate her stability in the Atlantic; but should that ocean prove more exacting, she has her Frahm anti-rolling tank in reserve to counteract the effects of broadside seas. The expectations of the builders are to be gathered from the fact that neither chairs nor tables are fastened to the floor, and can be moved about as freely as in a house.

Naturally, there is a family likeness in many of the decks of all large ships, but it is claimed, and we believe rightly claimed, that this "B" deck is unique. It is almost entirely given up to living rooms, and that the former plan of making the dining-room serve both for eating and sitting has been abandoned in this as in most recent vessels. Indeed, the first-class saloon, which measures 98 ft. wide and 28 ft. high, has been relegated to the "F" deck, and, although it is an exceedingly handsome apartment and surrounded by a gallery, it has lost much of its former importance. There are four great rooms on the "B" deck, the social hall, the palm court, the Ritz-Carlton restaurant, and the grill room. Of these, the most important is the social hall, not only for its size and beauty, but also as marking the change of ideas and habits among passengers. In this both sexes can chat, read, write, and smoke, and in the evening, when the removal of the splendid pink carpet reveals the parquet floor, they can dance. It is 72 ft. long, 58 ft. wide, and 18 ft. high. The decoration is in the Louis XV style, the walls being panelled in light oak, carved with garlands, and the lighting being from an immense glass roof, and from side windows 10 ft. high. The special feature, and one that will be be greatly appreciated by dancers, is that there are no pillars. The roof is in one span, and is hung from bow-string girders upon the top deck. This deck covers the superstructure only, and does not extend to the sides of the ship. It is largely occupied by the skylights over the social hall and the other rooms, and, further, accommodates collapsible boats and a number of electrically-driven fans for ventilation purposes. Hence it has but little accommodation—and less attraction—for passengers.

The Grand Stair Case

Next to the social hall comes the grand stair-case, with its electric lifts, and beyond it the palm court or winter garden. The entrance hall is 98 ft. wide and 69 ft. long, and there are two other stairways for insuring communication between the various decks. Three passenger lifts serve the different decks. The lifts are each driven by a 6-h. p. electric motor, and each lift can carry eight passengers. They travel from the "G" deck up to the "A" deck. The walls of the palm court are finished in light gray, overlaid with gilded trellis work. Six steps lead from this into the restaurant, which is on a higher level, but is only separated from the winter garden by a dwarf iron screen. Here the scheme of decoration is *directoire,* with green marble columns. Both these rooms are lighted from above, there being nothing above them except the skylight on the top deck, which protects the glass ceiling.

Forward of the restaurant comes the grill room, which has large windows all around, giving an unobstructed view ahead and to both sides. In this room the passenger who likes simple food, of the best quality and admirably served, can satisfy his desires, while those of more elaborate tastes can take their choice between the French cooking of the dining room and the more artistic and more expensive achievements of the chefs whom the Ritz-Carlton Co. send to minister to their wants and educate their tastes. The other rooms on this deck are the ladies' drawing room, a writing room, a smoke room, and others of smaller size.

The smoke room is situated over the grill room. Here the effort to create an illusion quite foreign to a ship is carried to the extreme limit, the design, which is due to W. E. Thornton Smith, being taken from two old Tudor houses, one of which is in Devonshire. The herring-bone brickwork over the fire-place was carried out by bricks taken from a cottage in Buckinghamshire. The pillars are of carved oak, and the deep frieze is also of the same material in high relief. The general effect is charming, as may be imagined.

The Baths and Gymnasia

Of the state rooms we have not space to speak at length, but we may mention that in the first class department only standing bedsteads are used. Each room has a fixed wash basin with hot and cold water laid on, while many of them have private bath rooms provided with hot and cold water. The plumbing work in the ship represents a decent fortune, while it must have involved an infinity of care and supervision, for a leaky joint might do immense injury to the expensive decorations in the neighborhood. There are 150 cabins with private bath rooms, and 200, each for one person only, in the first class department. In all there are 714 beds and 194 sofa-beds.

There are also two self-contained flats, each of which is listed at £450 for the trip in the off season, and £1000 in the high season. Each flat

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contains a dining room, a drawing room, a veranda with large windows, two bed rooms, two bath rooms, dressing room, box room, and pantry. There is also accommodation for four servants outside.

No first class steamship is now complete without a swimming-bath and a gymnasium, and, of course, both of these are to be found on the Imperator. The former is situated on the "F" deck next to the first class dining saloon, and is of ample proportions. It is surrounded by 18 decorative Pompeiian pillars, its total length being 65 ft. and the width 41 ft., with a maximum depth of 7 ft. It is fed with warm sea water through decorative cascades, and is surrounded with dressing and rest rooms in the Pompeiian style. In connection with this department there are also a series of hydropathic rooms for Turkish, steam, electric, and other baths, so that the busy traveler can utilize the voyage by undertaking a "cure" under advice of one of the three medical officers. There are separate gymnasia for the first and second class passengers, each provided with apparatus for taking exercise, both gentle and violent.

The Second and Third Class Accommodations

So far we have spoken only of the first class accommodation, but much might also be said in praise of the second, which is quite equal to that which satisfied first class passengers only a few years ago. There are a large dining room, reading and writing rooms, music saloon, smoking room, and electric elevator. The cabins for two, three, and four persons are situated over four decks. They comprise 401 beds, 191 sofa-beds, and 14 children's beds. The third class passengers have also a spacious dining and reading room, and are berthed in cabins for two, three, four, and six persons, containing in all 962 beds. Even 1,006 of the 1,772 steerage passengers have cabins for two, four, and eight persons. The contrast between their accommodation and that which obtained thirty years ago is as striking as the increase in luxury in the first class quarters.

The vessel was built by the Vulcan-Werke, Hamburg, for the Hamburg-Amerika Line; she is the largest ship now afloat, and is the first German merchant ship to have four turbine-driven propellers. Her principal dimensions are the following:

Length over all, 918 ft. 10 in.; length between perpendiculars, 880 ft.; breadth, 98 ft.; draught under full load, 35 ft.; displacement under full load, 57,000 tons.

The Imperator therefore is double the size of her predecessors, the Amerika and Kaiserin Auguste Victoria. She has been built to the rules of the German Lloyd, and to those of the Seeberufsgenossenschaft, and of the Emigration Bureau, which in many points are exceeded in stringency by those of the builders themselves. The hull is divided into 13 water-tight compartments by 12 water-tight transverse bulkheads, eight of which extend up to the second, or "F," deck—i. e., far above the load water line; the first four bulkheads forward extend up to the "E" deck. The hull for a third of its length forward is further provided with longitudinal water-tight bulkheads or inner skin at a distance of 1.5 m. (59 in.) within the outside plating. All water-tight doors in the different bulkheads, including those which establish communication between the stokeholds and engine rooms, are operated automatically on the Dorracher, or Stone-Lloyd system from the bridge. The double bottom is 70.85 in. high, and extends almost over the whole length of the ship. The hull is bossed out at each side at the stern to provide tunnels for the two wing-shafts. The rudder weighs 90 tons, and is carried on five gigantic pintles. The diameter of the rudder post is 2 ft. 6 in. It is of cast steel, made by Messrs. F. Krupp, of Essen, and is built in two pieces. It is 57 ft. 5 in. high, and weighs 110 tons.

There are five complete steel decks, one part deck astern and two forward, also four superstructural decks in the middle portion of the ship. The deck houses contain the first class saloon and rooms. The three funnels are 68 ft. 10 in. high above the highest deck, and are elliptic in section, the major axis being 29 ft. 6 in., and the minor axis 18 ft. The ship carries two steel pole-masts, which rise to a height of 246 ft. above the keel.

The Machinery

The propelling machinery consists of Parsons steam-turbines, a high-pressure and an intermediate pressure turbine driving the two inner shafts, and two low-pressure turbines driving the wing shafts; they are designed to give the ship a speed of 22.5 knots when developing together 62,000 shaft h. p. For going astern there are two high-pressure and two low-pressure turbines, calculated to develop together 35,000 shaft h. p., the high-pressure turbines being on the inner shafts, and the low-pressure astern turbines on the wing shafts. The propellers are 16 ft. 5 in. in diameter, and run at 185 revolutions when imparting to the ship the speed of 22.5 knots. The propeller thrust is taken up by thrust-blocks having for the four a total bearing surface of 75.3 sq. ft. The turbines exhaust into four condensers, having each a cooling surface of 16,146 sq. ft. The cooling water is supplied to the condensers by four centrifugal pumps 4 ft. 3 in. in diameter, driven by two steam engines. The condensed steam is delivered by four Weir duplex air pumps into two tanks in the double bottom, whence, together with the fresh water proceeding from three boiler feed water evaporators, it is delivered by four duplex feed pumps to the boilers. Each feed water evaporator has a capacity of 100 tons per 24 hours. There are two auxiliary condensers provided with two auxiliary circulation and two auxiliary air pumps. There are four steam-driven bilge pumps, each of 4,944 cu. ft. capacity per hour, to exhaust the engine and boiler room bilges, and four steam-driven water ballast pumps. The turbine and shaft bearings are lubricated by six oil pumps.

Steam at 16 Atmospheres

The turbines are supplied with steam at 16 atmospheres (235 lb. per sq. in.) above atmospheric pressure from 46 single-ended water-tube boilers of modified Yarrow type, having a total heating surface of 203,000 sq. ft., and a total grate area of 3,767 sq. ft. The boilers are mounted in groups of 11 and 12 in four stokeholds, separated from each other by four water-tight bulkheads. The required forced draft is supplied on the Howden system by four fans, 13 ft. 9 in. in diameter, and delivering air through conduits 45 sq. ft. in section under the boiler grates. The ashes are dealt with by four ash-ejector pumps, having a total capacity of 6,357 cu. ft. per hour; also by 16 ash-ejectors, six ash hoists, and three ash-slaking valves.

The ventilation of all the engine and boiler rooms is insured by seven fans. The coal bunkers are to the side and between the stoke holds; they have a capacity for 8,500 tons of coal. The four stokeholds are 74 ft. 9 in. in length each, and with the coal bunkers occupy the whole breadth of the ship at her central portion. There are three engine rooms: one, 68 ft. 10 in. in length, in the center line of the ship, and containing the high pressure and intermediate pressure turbines; and two side engine rooms, 95 ft. in length each, slightly aft of the former, and containing the two

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low-pressure turbines driving the wing shafts. The forward engine room is divided into three water-tight compartments, and each of the two aft rooms into two water-tight compartments.

There are five turbo-dynamo sets located in the port side low-pressure turbine room, which generate current at 110 volts and 2,000 amperes for light and power. Besides these five sets there is on the boat deck a petrol engine-driven emergency dynamo which generates current at 100 amperes, and is capable, should the five sets in question fail, to supply current for lighting the ship throughout, and especially the deck carrying the life saving boats; it can at the same time supply current for working the apparatus on the bridge, and the wireless telegraph station. This latter contains two main and two spare antennae and two receivers for long and short-distance waves; the installation has a maximum range of 1,500 nautical miles.

Fireboat David Campbell

Description and Trial Trip of the Fire Fighting Craft Built for the Port of Portland

ON May 24 the new fire boat David Campbell made her official trial trip to the mouth of the Willamette river, a distance of 12 miles, and from there ran to St. Helens and return, a distance of 15 miles each way, averaging a speed of 16.3 miles per hour, which was very satisfactory, as the contract called for 14½ miles per hour.

The boat was designed by William J. Wood, naval architect of Chicago, Ill., and Fred A. Ballin, consulting engineer, of Portland, Ore., superintended the construction and installation of machinery.

The Smith & Watson Iron Works of Portland, Ore., took the contract for the boat over a year ago and sublet the hull to Johnson Bros. of Ferrysburg, Mich., who fabricated the hull and shipped it on the cars to Portland, where it was assembled and riveted.

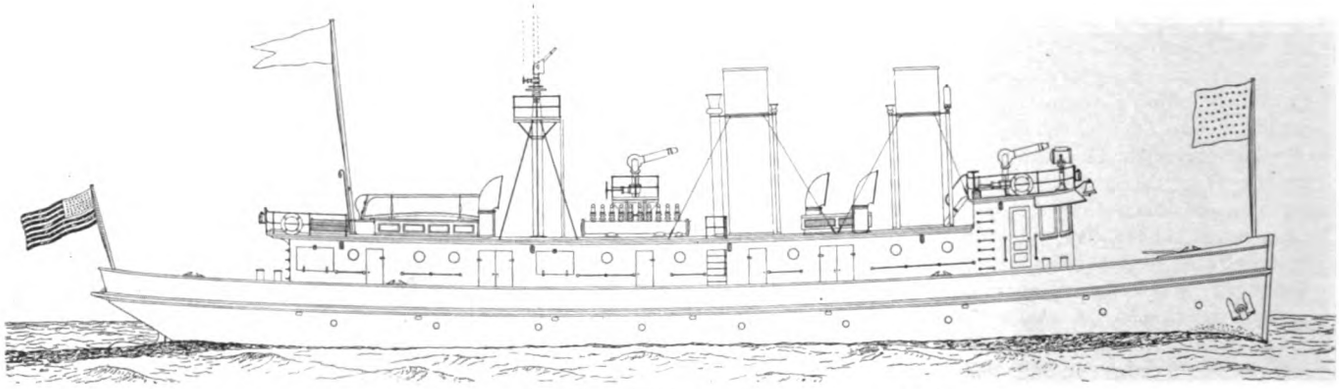
The boat was named after the late chief of Portland Fire Department, who lost his life in a fire over a year ago.

The principal dimensions of the boat are: Length over all, 125 feet; beam molded, 25 ft.; depth molded, 12 ft. 9 in., and 9 ft. draught.

The hull is divided into six water-tight compartments by five transverse bulkheads. The first compartment is used as a trimming tank and chain locker. The second compartment is used for stores. The third compartment is the oil bunker of 230 barrels capacity, fitted with oil-tight scuttles on deck, and in it a middle line wash bulkhead. The fourth compartment contains two Ballin water-tube boilers, with space on sides, which will be utilized for coal bunkers in the event of the boat ever using coal instead of oil for fuel. Four coal scuttles on each side are fitted for this purpose, and abaft the boilers are two sets of centrifugal fire pumps having a combined minimum capacity of 9,000 gallons of water per minute, the twin propelling engines, auxiliary machinery and abaft same a work shop. The fifth compartment is used as a trimming tank and abaft it is the fantail with steering gear.

On the main deck is a steel deck house 84 ft. long and 15 ft. wide amidships with the roof extending 2 ft. over sides to increase the area for working above and afford the men shelter on deck in emergencies. The deck house is divided by three steel bulkheads, and special provision made for stiffening roof under monitor turrets, water tower and funnels; a flat top steel skylight is built over engine room and a dog-kennel top skylight of steel over boiler room.

In the deck house is the steam steering engine boiler room, nozzle rooms, hose rooms, stairways to top of house, engine room, toilet rooms and a deck buffet for service of hot coffee on long watches during fire fighting.



PROFILE OF FIREBOAT FOR THE PORT OF PORTLAND

As a protection from low piles in winding or wearing away from docks about which the boat will always operate, a heavy fender wale is fitted from stem to stern 14 in. wide by 9 in. thick, tapering to 4 in. at face and protected with steel half ovals fastened with flush headed spikes.

A balanced rudder of heavy construction with forged frame covered with 12½-lb. plates (the space between plates

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filled with concrete) is suspended from inside of hull by a cast steel rudder carrier fastened on stock below quadrant, and revolving in a brass cone-shaped bearing ring, set in a cast steel collar support securely riveted to a heavy sole plate, which rests on top of stern post.

The propelling machinery consists of two high-pressure, direct-acting inverted double-cylinder condensing marine engines with cylinders 14 in. diameter with 20 in. stroke, and developing 1,760 I. H. P. designed for working under full boiler pressure of 250 lbs. and making 225 revolutions per minute, driving two cast steel sectional propellers, 7 ft. diameter and 8 ft. 6 in. pitch.

Fire Pumping Machinery

The fire pumping machinery consists of two horizontal steam turbines directly connected to two stage centrifugal pumps. Each pump when running in parallels or two stage has a capacity of 4,500 gallons of water per minute, or a total capacity of 9,000 gallons of water per minute against a pressure of 150 lbs. when operating at 1,800 revolutions per minute. The turbines work under full boiler pressure of 250 lbs. and each exhaust into an independent vertical jet condenser, size 8 in. high pressure, 12 in. low pressure and 22 in. air cylinders having a capacity to condense 15,430 lbs. of steam per hour, giving a vacuum of 26 in. under full load. The fire pumps are so arranged that they can be connected in series or four stage, and under this arrangement their combined capacity is 4,500 gallons per minute against a pressure of 300 lbs. per sq. in. When so arranged one pump takes suction direct from sea, and discharging at 150 lbs. into the suction of the other pump which delivers into fire mains at 300 lbs.

There are two monitors, one 6 in. on top of pilot house and one 8 in. on top of deck house amidships.

A Ballin patent telescoping water tower is installed on top of deck house, consisting of two tubes, one telescoping into the other; the inside tube of brass 27 ft. 6 in. long by 6 in. in diameter is connected by a flange to the discharge line of pumps; the outer tube is of solid drawn steel tubing 8 in. outside diameter by 5/8 in. thick, 30 ft. long, accurately turned and finished to form proper bearing surface in sleeve and roller bearings at top pedestal, which takes the thrust when working under pressure; brass hand wheels are fitted for clamping and turning the water tower in any direction. The nozzle is fitted for 2, 3 and 3½ in. tips, and can be raised or lowered by a galvanized steel wire cord running on a drum secured to turning wheel.

In addition to this equipment there are two hose manifolds 14 in. in diameter on top of deck house, fitted with twenty 3½ in. flanged outlets to hose pipes. All pressure valves are extra heavy and tested for 300 lbs. working pressure.

Steam is supplied by two Ballin water tube boilers, designed and built for a working pressure of 250 lbs. to work with natural and forced draft, using crude oil as fuel. The combined heating surface of both boilers, measured on the outside of the generating tubes, in actual contact with the fire and hot gases, is 7,000 sq. ft.

Feed water is supplied to the boilers by two vertical duplex pumps, size 7½ in. steam cylinder, 5 in. water cylinder with 8 in. stroke, either of which is of ample capacity for feeding boilers when steaming at full pressure.

Following the return of the fire boat from her official run, the fire-fighting apparatus was tested unofficially in the river, and again the requirements were exceeded. Approximately 9,500 gallons of water was discharged from 12 streams and the big nozzles each minute, 500 gallons more than required. The water throwing exhibition was beautiful, the giant sprays shot high into the air, then fell, cataracts of dazzling white, in the sunlight.

Aboard the David Campbell during the speed tests were Mayor Rushlight and Fire Chief Dowell, and many city officials, representing the municipality.

Government Steamer Launched at Quebec

Geo. T. Davis & Sons, Levis, Quebec, launched the Canadian government hopper barge No. 1, built for services in the River St. Lawrence on May 20. The vessel is the first of its kind to be constructed on Canadian soil and is the pioneer of a large fleet to be built in the near future for assisting in the increased dredging operations of the river. The dimensions are as follows:

	Ft.	In.
Length B. P.	180	
Breadth	32	
Depth	14	6
Draught	12	
Gross tonnage, tons	850	

The vessel is classed 100 A1, Lloyds river service under special survey and equipped acording to Canadian government inspection. The discharging arangements are very complete and consist of a series of six double doors on each side of the vessel operated simultaneously or separately, the doors being of extra heavy design and so arranged that when open, they do not extend below the bottom of the hull. The accommodation for officers and crew is situated on the lower deck forward and consists of large rooms for the officers with a common mess room for all and separate rooms for the seamen and firemen. Ample space has been provided for store rooms, etc., and the baths and lavatory arrangements show that more than the usual consideration has been given to the comfort of all on board.

The machinery, developing about 500 I. H. P., consists of a set of triple expansion engines, 14¾ in., 24 in. and 38 in. diameter cylinders x 22 in. stroke, steam being supplied by two horizontal multitubular boilers, 10 ft. diameter by 10 ft. in length, working at a pressure of 180 lbs. per sq. in. There are two feed pumps of Weirs vertical direct acting type, fitted in connection with Weirs air pump, feed heater, evaporator and filter. The condenser is circulated by means of a Drysdale centrifugal circulating pump. Two large Weirs general service pumps, two separate acting bilge pumps, one sanitary and one fresh water pumps are placed in the engine room and a patent ash ejector is fitted in the stokehole.

The deck machinery consists of a capstan at the after end, a winch for operating the hopper doors and a windlass on the forecastle deck for the anchors. There is a steam steering gear controlled from the flying bridge and a very complete installation of electric light throughout the ship.

Steam heating, fresh water service and sanitary service is also very complete and generally speaking the vessel is equipped in a first-class manner.

In appearance the new vessel represents the usual type of hopper barge, having a forecastle deck, main deck, bridges and gangway over the hopper with the machinery placed at the after end. The trial will, no doubt, prove the efficiency of the new barge and from the appearance at present, great credit is due to the builders. The launching ceremony took place in the early hours of the morning and was a complete success, the vessel taking the water in a graceful manner amid the cheering of a large crowd of interested spectators.

It is most gratifying to know, however, that the berth lately occupied by the hopper barge is now being rapidly put into order for the erection of one of the six large scows for which Geo. T. Davis & Sons received a contract recently.

John E. Hand & Co., manufacturers of nautical instruments, have moved to 224 Walnut street, Philadelphia.

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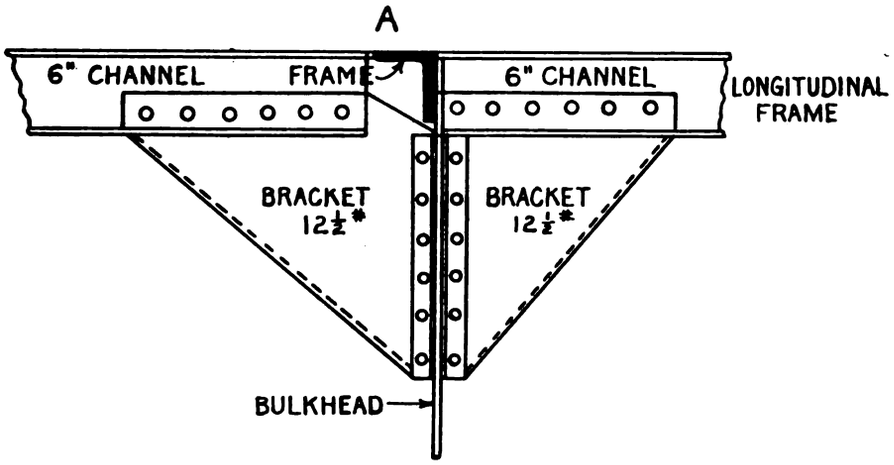
Isherwood System of Construction

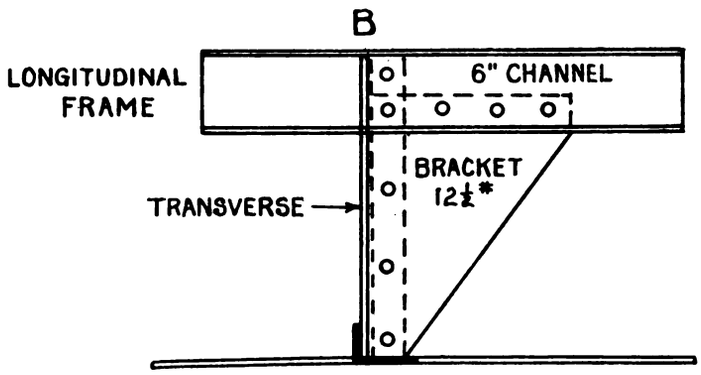
Showing the Connection of Lonitudinal Frames to the Bulkheads and Transverses

By Robert Curr

THE accompanying sketches show the connection of longitudinal frames to the bulkheads and transverses.

Sketches A and C show the most vital point of the longitudinal framing. The connection to the bulkhead must be equal to the weakest part of the channel and care must be taken to have the bracket plate large enough and in thickness to correspond to the other parts.





The longitudinal frames run from bulkhead to bulkhead and when the channel cannot be secured long enough they are butted together and fastened with straps of the same material and a number of rivets equal to the section.

The longitudinal frames from the stem to the collision bulkhead No. 2 are only about 12 feet long, in the bottom from No. 2 to tank division No. 12 the longitudinals are 60 ft. long, so that it is more practical to cut them, making the longitudinal frames in the bottom between No. 2 and 12 in two pieces. Care must be taken to cut the frames at least four feet clear of the bottom plating butts and each other.

The next bottom division is at No. 24, making the longitudinals 72 ft. long, which will require the same arrangement as in the fore tanks. From 24 to 29 (the tank end) the longitudinals are gradually omitted in the bottom, which is shown on the body and expansion plans.

In the hold the longitudinal frames run from No. 2 to No. 20, making them 108 ft. long.

The longitudinals are cut and made up similar to the bottom arrangement.

Above the tank the longitudinals run from No. 20 to 24 and from 24 to 30 and aft of No. 30 they are carried around the stern where practical.

It will be seen that the longitudinals as well as the transverses can form a belt around the vessel lengthwise and can be made to any strength desired.

The importance of the Isherwood construction may be realized when we consider that the combination of the transverses and longitudinals can be made self supporting and can add to the longitudinals as well as the crosswise strength, while the cross framing of a vessel in no way contributes to the longitudinal strength.

Sketch A shows the underside of the longitudinal frame connected to the bulkhead with bracket plates 5-16 in. thick and 6 ¾ in. diameter rivets each way. Sketch C shows the same section from the outside.

Sketch B shows the underside of the longitudinals at the transverses with the number of rivets connecting the two together.

Sketch D shows the same section from the outside.

Sketch E shows the connection of the longitudinals to the watertight divisions and the number of rivets necessary to retain the strength.

The connection shown is adopted at all the divisions, making the two longitudinals equal to a continuous member.

Sketch F shows the connection of the deck longitudinals to the bulkheads. This arrangement is carried out on all longitudinals between the side of the vessel and the hatch openings, doing the same work as in the bottom and on the sides.

The Newport News Ship Building & Dry Dock Co., Newport News, Va., was the lowest bidder for the construction of three large freight steamers for the Mallory Line. It bid $699,500 each.

This is the eleventh of a series of articles on the Isherwood system of construction which began in the September issue of THE MARINE REVIEW. The first article dealt with the general specifications of the steamer, the second with the sheer, half-breadth and body plans; the third explained the method of getting the sheer; the fourth dealt with the longitudinal and transverse framing; the fifth with offsets; the sixth with the shell plating; the seventh with the shell plating expansion; the eighth with the arrangement of plates and angles forming the spar deck; the ninth with the transverses; and the tenth with bulkhead construction.

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Trip on Lake Freighter

How the Great Lakes of North America Impressed an Englishman

THE point of view is always interesting, and the following account of a trip up the lakes, taken by an Englishman two years ago, makes very good reading, even though there is nothing new in it. It was written by E. D. Nicol, Sunderland, England, and sent to the Upson-Walton Co., Cleveland:

In June, 1911, being in Cleveland, O., U. S. A., and meeting a good friend, he arranged a trip for me on the Great Lakes of America. I was highly delighted at the prospect of this trip and the reality more than realized my highest expectations.

Proceeding by the Lake Shore railway to the port of Lorain, about 25 miles distant, I joined the lake trader "Henry H. Rogers". I was fairly well acquainted with most kinds of steamers, but this one was quite a revelation to me. Of course, it was built for the particular trade of a "lake carrier", and answered this purpose thoroughly. Her dimensions were:

Gross tonnage	7,053 tons
Net tonnage	5,444 tons
Length	583 feet
Beam	58 feet
Depth	32 feet

She carried over 10,000 tons iron ore, and was specially built to load and discharge quickly. When I joined her at Lorain she had not completed discharging her cargo of iron ore. She was moored alongside a quay which had rails quite close to its edge. On these rails ran electric cranes which were fitted with grab-buckets and guided in their operations by a man inside a circular iron casing with glass windows in it; so that he could see all around him. These grabs lifted ten to twelve tons at one movement. I timed the period required to lift this quantity of ore and discharge it into a wagon on the quay, or deposit it on a heap above the wagon way, when no wagon was there, and thus save time. From one position to the same position it was exactly 55 seconds. There were four of these cranes working steadily and it is an easy calculation to find out that they could discharge close on 10,000 tons in 4 hours. Two hours were allowed for moving the cranes to get grabs to fit into one or other of the many hatches. I will describe the loading process later on.

We left Lorain at midnight of Saturday, June 10. Our course lay across Lake Erie to the entrance of Detroit river. These lakes are of an enormous size. Following are dimensions:

Lake Erie, Square miles, 10,000; greatest length, 250 miles; breadth, 60 miles; maximum depth, 240 feet.

Lake Huron, square miles, 23,000; greatest length, 220 miles; breadth, 105 miles; maximum depth, 1,000 feet.

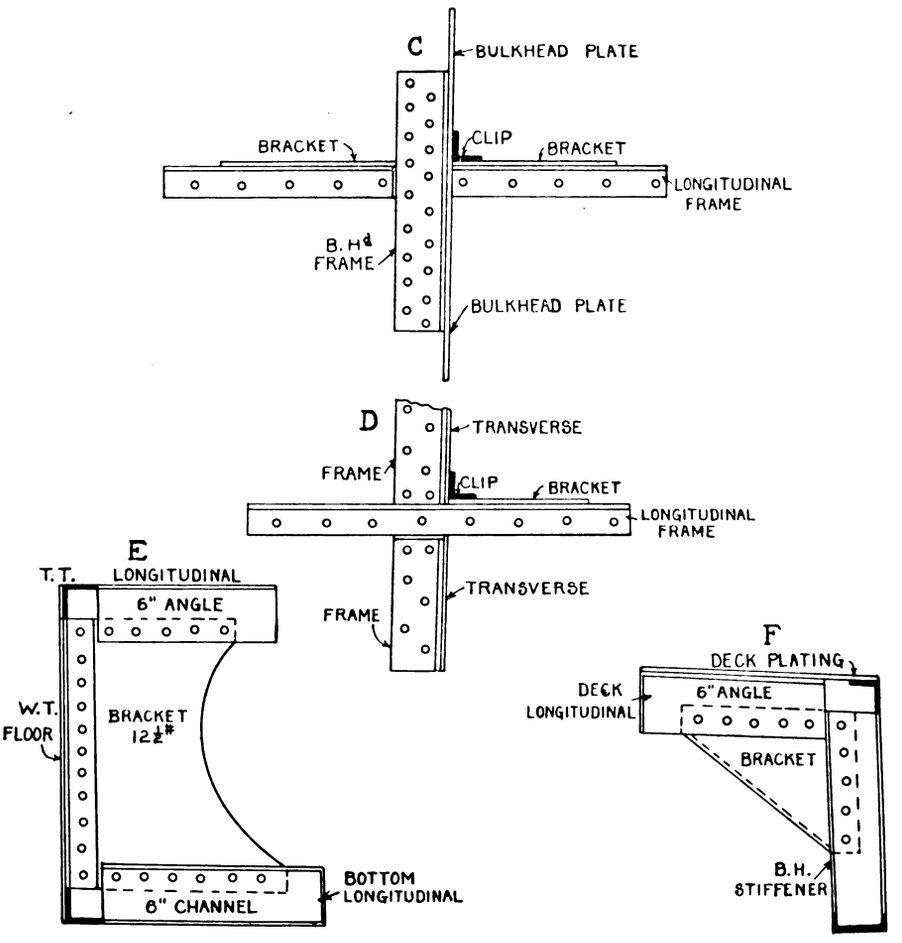
Lake Superior, square miles, 32,000; greatest length, 390 miles; breadth, 160 miles; maximum depth, 1,400 feet.

And beside these there is the small St. Clair Lake of about 1,600 sq. miles.

Passing Detroit city we came across what is, I was told, the only marine post-office in the world. This is a steam launch which acts as a postman, meeting all steamers passing up and down and delivering any letters, etc., for the boats as they pass along. We got a budget, merely slowing down for a little to get it.

We next entered Lake St. Clair, then St. Clair river. The Americans call this point the Venice of America. About the only resemblance I could see was that they both had a quantity of water and this part had a few wooden houses built on piles a little way in the water.

There are a great many shallows and solitary rocks just showing above the water all over these lakes and all are well buoyed or lighted or marked with beacons. These make the navigation somewhat intricate but all captains and mates and pilots must know each, and be able to steer through them by day or night. The depth of water varies in the channels from about 25 ft. to very much more. The regular lake trader is built with a high fo-castle on which stands a "house." The "ground floor" is used as saloon and sleeping cabins. The upper part is the pilot or steering house and is all glass in front. Right over the stem is the steering pole indicating the stem of the



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vessel, which itself is not seen owing to the elevation of the position of the wheelsmen. The position of this pole at night is shown by an electric light fixed at its extreme end. The wheelsman and chief mate take *"trick"* about in steering, each trick being six hours without any relief. There are actually no real sailors on these crafts, as there is no real sailors' work to do. A new flag was required to be fixed on halyards and I and the captain were the only ones on board who could make the necessary splice. I had a very nice and large "bedroom" allotted to me. It was handsomely furnished and contained among other furniture, a grand brass bedstead. Adjoining was a very fine bathroom where was laid on, both hot and cold water. We had three meals a day. Breakfast at 6 a. m., dinner at noon and tea at 6 p. m. All hands excluding firemen and men on duty *"mealed"* together. The food was of the very best and without stint. I must confess I was sometimes hungry between meals. The cook and his assistants were full blooded negroes. All the crew from the captain downwards chewed tobacco and spittoons were provided for their special use. They also swore terribly. I did not like the tobacco chewing but I hated the swearing. I think I cured them of this evil habit by arranging to touch the top button of my vest every time I heard an oath. We formed a *T. B.* Society for the prevention of swearing. I had a letter from the captain after I got home and he informed me the T. B. Society was flourishing. We had one touch of nasty weather in Lake Huron. It came in thick and nasty with heavy drizzling rains. We arrived at Superior City at the far end of the lake of the same name, on Tuesday about 5 a. m. We had sailed 814 miles in 77 hours, thus averaging 10½ miles per hour. We were exactly same time in returning.

The Days Before the Canal

We loaded 10,000 tons of iron ore in less than six hours. The "Henry S. Rogers" has thirty-six hatchways and was double skinned, carrying water ballast when light, between the skins. She was moored along side what the Americans call a dock and what we call a quay. There were four quays varying from 1,812 ft. to 2,244 ft. long 73 ft. to 76 ft. high and 63 ft. wide. I saw an ore train arrive with 70 wagons, each carrying 40 tons, meaning 2,800 tons of ore.

Lake Superior is connected with Lake Huron by rapids which of course are not navigable. The distance of these rapids was done by haulage and transportation in the old small craft days. Now a canal has been built 900 ft. long on the American side of the rapids. One is being constructed on the Canadian side, 1,200 ft. long. This canal is frozen 3 months in the year and notwithstanding this *more tonnage passes through it in nine months than goes out and in to London, Liverpool, Cardiff and Hull in twelve months.* Last year the amount was about 72 million short tons of 2,000 pounds. Six of every seven of the 84,628,657 net tons of domestic freight shipped in 1910 from American ports on the Great Lakes were handled in bulk cargoes. More than half, 46,500,000 net tons, was iron ore, 22,600,000 tons were coal and over 3,000,000 tons were grain.

Methods of Loading and Unloading

"With such an enormous traffic to be served it is, perhaps, not to be wondered at that inventive genius has been busy; that highly specialized types of ships, docks and appliances for loading and unloading bulk cargoes have been evolved; and that such cargoes are handled in less time and at less cost in the harbors of the Great Lakes than in any other ports in the world.

"In 1855, when the Soo Canal, between Lakes Superior and Huron, was first opened, 1,449 tons of iron ore were shipped from Lake Superior. Many men and many days were occupied in loading this ore into the little schooners which carried it to Cleveland, and the unloading took longer still. The freight paid was $3.00 per ton. It is now 40 cents per ton.

"Methods of loading and unloading have changed even more than rates of freight. The modern ore dock is a huge structure, generally of timber, although the very largest type is made of concrete and steel. These docks rise 75 or 80 feet above the water and some of them are nearly half a mile in length.

"The ore is hauled to the dock in hopper-bottomed cars and dropped into storage bins, or "pockets" as they are usually called. The pockets at Superior City have a capacity of 362,490 long tons. When the ship comes alongside the dock the chutes are let down, the slide drawn up, and the ore goes rushing into the hold at a rate of hundreds of tons a minute, while the great ship sinks swiftly down into the water as she gets her load.

"Great Northern Dock No. 4, made the world's record for loading on Sept. 8, 1911, when 10,592 tons of ore were put into the steamer "W. F. Corey" in twenty-five minutes. While special preparations were made in this case for the edification of a party of U. S. Steel Corporation officers it shows what can be done.

"Ships have changed as much, or more, than docks and freight rates, for. instead of a few little wooden schooners, there is now a great fleet of huge steel steamers. The largest of the lot, the Col. J. M. Schoonmaker and the Wm. P. Snyder, Jr., are each 617 ft. long, 64 ft. wide and have a capacity of 14,000 tons. They are said to be the largest bulk freighters in the world (in 1912).

"Ashtabula and Conneaut, Ohio, receive more iron ore than any other ports on the Lakes, and it is *"nip and tuck"* as to which gets the most. In 1911 Conneaut got 6,931,273 tons and Ashtabula 6,359,131. Up to October first of this year, Conneaut had received 6,209,000 tons and Ashtabula 6,100,582.

"Both towns claim to de some lively unloading, too. Ashtabula tells of the day when the steamer "Shenango" reached port at 3 a. m. with 12,320 tons of ore in her hold, had it taken out, was shifted to another dock, and left port at 9 o'clock the same evening, carrying 12,000 tons of coal. Then Conneaut speaks up and declares that she holds the world's record for rapid unloading and proceeds to give the details. On August 8, 1912, the steamer "P. A. B. Widener" came alongside the dock with 11,912 tons of ore in her hold. Two hours and fifty minutes later every ton of it had been taken out and put into cars for shipping to Pittsburgh furnaces.

Unloading Ports

"One Hulett unloader, electrically operated, took 2,093 net tons of ore out of the Widener on the occasion named. That means that the huge machine reached out over the ship, dived down into the hold, grabbed twelve tons of ore, lifted it out, backed up, and dropped its load into a waiting freight car once every minute for two hours and fifty minutes without a stop."*

And that's how they handle iron ore on the Great Lakes. I had a most enjoyable six days and was very kindly treated by the captain, Sam Allen. The best part of the whole was it did not cost me a penny.

*Between these marks are extracted from an American paper sent me.

The Brooklyn navy yard will build the sister ship to the battleship Pennsylvania.

The Union Iron Works, San Francisco, is building an oil tanker for the Associated Oil Co.

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Profit Sharing Plan

The Interlake Steamship Co. Has Invited Its Masters and Engineers to Participate in Stock Subscription on Very Favorable Terms

THE old Gilchrist Transportation Co., long in the hands of receivers, was one of the problems of lake operation at the opening of navagation. The company was hopelessly insolvent and the vessels were purchased by a creditors' committee represented by a number of Cleveland banks at marshal's sale in the federal court at Cleveland at approximately two-thirds of their appraised value. Being without trade connections of any sort, the vessels were not a particularly valuable asset to the creditors' committee though they were bought cheap enough. A new company was accordingly formed by interests intimately associated with the Lackawanna Steamship Co. to take over the seventeen vessels of the Gilchrist fleet from the creditors' committee, as well as a number of other fleets, and the name of the Lackawanna Steamship Co. was changed to the Interlake Steamship Co., as possessing a more comprehensive title. The purpose in buying other fleets as well as the Gilchrist steamers was to give the company a sufficient tonnage to warrant its carrying its own insurance. The Interlake Steamship Co. controls thirty-seven steel steamers and two steel barges and is managed by Pickands, Mather & Co., of Cleveland.

Contents of Circular

In an endeavor to enlist the permanent interest of the master and engineer in the operation of this fleet, the company has set aside 2,500 shares of stock to be subscribed for by the masters and engineers. The maximum number of shares allotted to a master is forty and to a chief engineer 25, and they are to be paid for in monthly installments deducted from salary and wages. All dividends declared and paid on the stock will be credited to the account of each subscriber as part of his payments until the stock is fully paid for. In the event that the subscriber desires to sell his stock, the company will buy it back at 105.

A trust fund of 300 shares, contributed by the banks and Mr. Coulby, has also been set aside to be held in trust until January 1, 1920, when with all accrued and paid dividends thereon, it will be distributed pro rata among the subscribers who have remained continuously in the employ of the company and who have retained their original certificates. The circular inviting the masters and engineers to participate in this subscription reads as follows:

"To the captains and chief engineers of the Interlake Steamship Co.:—

"As you are no doubt aware, in the enlargement of this company it bought from a committee representing the banks of Cleveland, at actual cost to them, seventeen (17) steamers, formerly owned by the Gilchrist Transportation Co., which the committee had purchased at United States marshal's sale, for about two-thirds of their appraised value. In part payment for said vessels the committee took a block of the capital stock of the Interlake Steamship Company, at par.

Method of Payment

"We believe that the men on our ships, who are charged with the responsibility of their navigation and operation, should be given an opportunity, if they so desire, of investing their savings in a business with which they are familiar, and for this purpose twenty-five hundred (2,500) shares of the capital stock of the company have been set aside and are offered to you for subscription under the plan herewith submitted:

"First: It is intended to offer five hundred (500) shares of said stock for subscription per annum at par, for five (5) successive years, and during that period each master, when assigned to a steamer, will be permitted to subscribe for from one (1) to eight (8) shares each year, and each chief engineer, when assigned to a steamer, from one (1) to five (5) shares each year. This will enable captains subscribing for the maximum amount to acquire, within the next five (5) years, forty (40) shares, and the chief engineers twenty-five (25) shares.

"Second: Payment of these subscriptions shall be in monthly installments, to be deducted from the salary and wages of the subscriber in such amounts as he may authorize, subject to the provision that stock subscribed for each year must be paid for within three (3) years from the date of subscription. Evidence of payment on account will be made by proper receipts sent out with pay voucher each month. Interest at five (5) per cent per annum will be charged on deferred subscription payments.

"Third: From the date of each subscription, and during the continuance of payment thereon, the dividends declared and paid on the stock will be credited to the account of each subscriber as part of his payments, until the stock is fully paid for and issued to him, after which dividends will be paid to him directly, as to all other stockholders.

"Fourth: Subscriptions will be cancelled for the following reasons:

"A. At the request of the subscriber.

"B. On his leaving the service or failing to resume employment when requested.

"C. Whenever payments on account of any subscriber shall have discontinued, without our consent, for a period of three (3) months.

"On such cancellation the subscription and all interest in the stock to which the same relates shall be terminated, and there shall be returned to the subscriber the exact amount of payments made on his account, with interest at five (5) per cent per annum from the time of payment. No credit, however, will be given such cancelling subscriber for dividends but no interest shall be charged against him on deferred payments.

Shares Held on Trust

"Fifth: When the stock is fully paid for it will be issued in the name of the subscriber. He may sell the certificate whenever he chooses, but as an inducement for him to keep it, while he remains in the service of the company, the following additional offer is made, namely:

"Three hundred (300) shares of the capital stock of the company, contributed by the banks and Mr. Coulby, will be held in trust until January 1, 1920, together will all accrued and paid dividends thereon. Said stock and said accrued dividends will then all be equitably distributed by the firm among the subscribers under this plan, who shall have remained continuously in the employ of the company and who shall exhibit to its treasurer the original certificate issued to them. It is expressly understood that the award of the firm to each subscriber of his proportion of said reserved stock and dividends shall be absolutely final, as the firm reserves the right to determine the equitable proportion thereof

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of any subscriber under all the circumstances.

"Sixth: In case a subscriber dies before his subscription has been fully paid the company will pay back to his estate or his beneficiary the money paid by him on account together with dividends paid on the stock subscribed for, less interest at five (5) per cent on deferred installments. If, at the time of decease of subscriber, his subscription has been fully paid but certificate not yet delivered, the company will turn over the certificate to his estate.

"Seventh: A subscriber may designate in his subscription the person to whom in the event of his death he desires the company to pay all amounts in connection with his subscription which would otherwise be payable to his estate. When such designation has been made, the company, upon satisfactory proof of death under the conditions of the subscription, will pay to the persons designated, if then living, all amounts in connection with the subscription which would otherwise be payable to the estate of the subscriber. When such designation has been made, the subscriber's estate shall have no claim to any such amounts unless the person designated should die before the subscriber, and in that event payment will be made to the subscriber's estate. By written notice delivered to the treasurer of the company, a subscriber may change the person designated.

"Eighth: Failure to present the original certificate as provided, or the withdrawal of a partly paid subscription, or failure to resume employment when requested, will constitute a relinquishment of all benefits referred to in this circular.

"Ninth: Subscriptions will be received until July 1st, 1913, inclusive, and first deductions will be made from June salary or wages.

PICKANDS, MATHER & COMPANY,
Managers.

British Naval Program

Under the British naval program of 1911-12 twenty ocean-going torpedo boat destroyers were ordered and of these Swan, Hunter & Wigham Richardson, Ltd., of Wallsend-on-Tyne, were entrusted with three, viz: H. M. S. Shark, Sparrowhawk and Spitfire. The first two were completed some time ago. The Spitfire has a displacement of about 1,000 tons, her length being 260 ft. and breadth 27 ft Three 4-in. guns and two torpedo launching-tubes are mounted on the vessel. The propelling machinery and boilers have been built by the Wallsend Slipway & Engineering Co., Ltd. The boilers are of the Yarrow water-tube type, fired with oil fuel. During all the trials an ample supply of steam was steadily maintained. The Spitfire has two screws, each driven by an independent Parsons' impulse-reaction turbine. The ahead and astern turbines are embodied in the same casing, steam being admitted to either section through groups of nozzles. The number of nozzles taking in steam can be controlled at will, in order to suit the speed at which it is required to work the turbines, and thus the best possible economy is obtained, both when running the vessel at high powers or at lower cruising powers. The trials which have been carried out so successfully included an eight hours' trial at full power, a trial for twenty-four hours at cruising speed to test consumption of oil fuel, gun trials under service conditions, testing the torpedo launching tubes, steering and turning trials running both ahead and astern and anchor trials and tests of the capstan gear, cable stoppers and nippers. After these exhaustive trials the turbines were opened out. The vessel was then made ready for sea in every detail and the acceptance trial was successfully performed to the satisfaction of all the Admiralty and other officials concerned, the ship running at three quarter speed for four hours.

Spitfire will be followed by Sarpedon and Ulysses at present under construction at the Wallsend shipyard. The former is launched and has her turbines and boilers on board. Ulysses will probably be launched in about four weeks' time.

The Geared Turbine

It has been said frequently that the geared turbine is not making nearly so rapid progress as was expected after the Vespasian experiment proved that it was really quite a practicable proposition. But it is making more rapid progress than the public generally are aware of. On the Clyde, for example, there are under construction at present three vessels of outstanding interest, each of which is to have Parsons' geared turbines. There has been a slight hint that the third Greenock Cunarder—the Transylvannia—would have machinery of this kind, but it has been only a vague sort of hint. As a matter of fact the Transylvannia is to have twin-screws, each driven by a turbine geared down by Parsons' helical gearing; and as the vessel, which is intended for the Mediterranean-New York service, is to be 550 ft. in length and of 15,000 tons gross, she will afford a splendid opportunity for testing the new mechanism. So will the Anchor liner, which is being built by Messrs. Alex. Stephen and Sons, Govan. She, too, weighs about 15,000 tons and measures 550 ft. in length, and she will have similar machinery. She is intended for the Anchor Line's Eastern trade through the Suez canal. In the case of the Cunarder, the turbines are to be made by the builders—Scotts company—and the reducing gear by the Parsons company, while the turbines and gear for the Anchor liner will both be made by the Parsons company. For all practical purposes these boats are both for one interest, as the Cunard and Anchor Lines are one in all but name and technical legal standing.

Tug for Erie Railroad

The Manitowoc Ship Building & Dry Dock Co., on June 28, launched the tug Frederick V. Robbins, built for the Erie railroad and designed to handle car floats in Chicago river. The Robbins is 90 ft. long on deck, 22 ft. beam and 13 ft. deep and is built entirely of steel, no wood whatever entering into the construction of hull or houses. She is equipped with a compound engine, 18 and 38 in. cylinder diameter by 30 in. stroke and a marine fire box boiler, 10 ft. 6 in. diameter, 14 ft. long, built for a working pressure of 130 lbs.

Contrary to ordinary practice in tug service, all pumps are attached to the main engine. It was not thought that the slight advantages in handling commonly supposed to be obtainable with independent apparatus compensated for the much greater fuel consumption, and maintenance.

A feature to which much interest will attach is that the Robbins is designed to burn anthracite pea coal and so far as known is the only commercial craft on the lakes to do so. This is in recognition of the efforts being made in Chicago by all interests towards smoke suppression. A Sirocco fan, driven by a Terry turbine, is fitted to supply the needful air under the grates.

The propeller is four-bladed, sectional, 9 ft. diameter, 11 ft. pitch.

The Manitowoc Company are also building two steel car floats, 175 ft. long, 35 ft. wide, 8 ft. deep. The floats carry two tracks, capable of holding five cars each, with a trucking platform between. The floats and tug go into commission Aug. 1, and will add considerably to the Erie's facilities for distributing freight in Chicago harbor.

The Racine Boat Manufacturing Co. has received contract to build three motor survey cruisers for the corps of engineers, War Department.

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Canadian Steamship Merger

The Canada Transportation Lines, Ltd., Take Over the Richelieu & Ontario and Other Companies

PRACTICALLY all of the leading Canadian steamship lines operating on the Great Lakes and St. Lawrence river have now been merged into one company. At a meeting of the stockholders of the Richelieu & Ontario Navigation Co., held on June 19 in Montreal, the action of the directors in selling the company as a going concern to a new company formed for the purpose was ratified. The Richelieu & Ontario Company at the time of the sale owned in whole or in part the stock of the following companies: Inland Lines, Ltd., Northern Navigation Co., Niagara Navigation Co., St. Lawrence River Steamboat Co., Thousand Island Steamboat Co. and Merchants' Montreal Line. The new company will be known as the Canada Transportation Lines, Ltd. Concerning the organization, President James Carruthers made the following statement to the stockholders:

The Companies Included

"This matter has received the most earnest and careful consideration by your directors and before sending out this notice, they were unanimously of the opinion that it was in the interests of this company to become part of a large organization. A new company has been formed called the Canada Transportation Lines, Limited, the authorized capital of which is $25,000,000, divided into 125,000 7 per cent cumulative preference shares of $100 each, and 125,000 ordinary shares, of $100 each, and with authority to issue 30-year first mortgage debenture stock of $8,000,000, bearing interest at 5 per cent, with power to increase the amount of such mortgage debenture stock from time to time, providing the proceeds thereof are used for the purchase of new boats or other property necessary for the company to acquire, and on the terms more fully to be set forth in the mortgage trust deed. The trustees for such debenture stock will be the Law Debenture Corporation, London, Eng., and the Prudential Trust Co., Montreal. The registrars for such stock will be the Royal Trust Co., Montreal, and Brown-Shipley & Co., London, Eng. The registrars for shares will be the Royal Trust Co., Montreal and London. Transfer agents, Prudential Trust Co., Montreal and London. Bankers, the Bank of Montreal. Brokers, J. & A. Scrimgeour, and Linton, Clarke & Co. Auditors, Marwick, Mitchell, Peat & Co.

"Further particulars of the new company and other matters connected therewith will in due course be given to shareholders. It is expected the new company will eventually acquire as going concerns, including all their assets, good will and profits for the current year, the following companies: Richelieu & Ontario Navigation Co., Ltd.; Inland Lines, Ltd.; Northern Navigation Co., Ltd.; St. Lawrence River Steamboat Co., Ltd.; Richelieu & Ontario Navigation Co. of U. S. A.; Quebec Steamship Co., Ltd.; Canada Interlake Line, Ltd.; Ontario & Quebec Navigation Co., Ltd.; Merchants' Montreal Line; S. S. Haddington; Thousand Island Steamboat Co., Ltd.

"The assets of the above companies have all been appraised by the Canadian Appraisal Co. and the accounts have been audited by Marwick, Mitchell, Peat & Co. Their reports and statements are open to the inspection of shareholders, and have been carefully examined by your board. Assuming the purchase to be carried out on the lines proposed, the new company will have assets as shown by the statement of the appraisal company of $33,055,538, in which vessels have been valued at $16,866,834; real estate, buildings and dock properties at $5,450,267.99 and $661,531.04 would be cash on hand, and $8,698,969.89 would represent the value of leases, contracts and goodwill acquired by the company and covered by ordinary shares. The new company would be free from debt over and above the debenture stock issued, and current accounts. The net earnings of the consolidated companies for the year ended Dec. 31, 1912, was $1,494,554.48, which shows an ample amount for the payment of interest on debenture stock and interest on the preference stock with a fair amount applicable to reserve and ordinary stock.

Increase in Net Earnings

"Allowing for new tonnage not in operation in 1912 on the same basis as earnings on similar tonnage in 1912, the increase in net earnings from this source alone over last year would amount to $263,000. In the item of insurance premiums I am advised by competent authority that a reduction of a considerable amount can be effected.

"The impression that prevails in some quarters that it will be necessary for the new company to advance rates in order to improve its financial position is entirely unfounded. After giving the matter careful consideration, I am of opinion that the savings that can be effected by the new company over the individual companies in handling their boats, in preventing overlapping, and by giving a prompter and more efficient service, would be very great.

Growth of Lake Transportation

"The important points that your directors had to consider was whether in their opinion it was in the interest of the Richelieu shareholders to sell out the assets and undertaking of that company, and if so, whether the Richelieu shareholders were in their opinion obtaining a fair share of the stock of the new company for the stock which they now hold. It is proposed that the shareholders of this company receive $12,000,000 7 per cent cumulative preference shares of the new company for the $10,000,000 of Richelieu stock. For example, each holder of 10 shares of Richelieu will receive 10 fully paid 7 per cent cumulative preference shares of the new company, and in addition 4 fully paid ordinary shares, which I think you will agree with your directors, is an excellent arrangement.

"The most important reason for your board being willing to advise the sale of the Richelieu assets and undertaking at the present time, is the fact that in their opinion it is essential to put the affairs of the company on the soundest possible financial basis both for the present and future requirements.

"The growth of the water transportation on the Great Lakes is assuming enormous proportions, and if Canada in the future is to continue to go ahead as she has in the past, the growth of this trade from year to year is going to be very great.

"This means that if we are to give satisfactory service to the farmers and shippers of this country we must be in a position to provide new boats from time to time and see that the grain grown in the country gets out of it in the promptest, cheapest and most efficient manner. In view of the world-wide financial stringency and the fact that requirements for money would be practically a matter from year to year, it commended itself to the judgment of your directors to sell to the larger organization."

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Subdivision of Ships

With a view to obtaining specific information from experts as to the character of structural arrangement of ships which should be required by national and international regulations to insure their safety at sea, the department of commerce and labor has appointed a joint committee of officers from the navy department and the department of commerce to prepare a list of questions relating to the bulkhead sub-division of vessels and other structural features affecting the safety of ships at sea. This committee consists of Rear Admiral Washington L. Capps, Naval Constructor D. W. Taylor, Geo. Uhler, supervising inspector general of the steamboat inspection service, and Eugene Tyler Chamberlain, commissioner of navigation. James Donald, naval architect of Boston, has been designated by a committee of ship builders on the Atlantic coast to represent them before the department, and has co-operated with the committee in preparing a suitable list of questions.

The information sought, especially that relating to trans-oceanic vessels, is intended primarily for the assistance of the department of commerce in preparing suggestions for such representatives as may hereafter be designated to represent the United States at a proposed international congress on safety of life at sea. While the authority for suitable structural sub-division of vessels to insure safety in operation is already contained in general terms in the provisions of statute law, the department desires to obtain the opinion of those highly qualified to render assistance in such matters with a view to improving present conditions.

While the necessity of life boat equipment is recognized, emphasis is placed upon the question of bulkhead sub-division as insuring the greatest security. The following are the specific types for which questions have been prepared:

Ia. Large passenger steamers carrying passengers, baggage, mail and express.

IIa. Steamers engaged in carrying both freight and passengers, but of such character that they must be regarded primarily as passenger vessels.

IIIa. Steamers engaged in carrying freight only or freight and some passengers, but of such character that they must be regarded primarily as cargo vessels.

Ib. Large passenger steamers carrying passengers, baggage, mail and express.

IIb. Steamers carrying both freight and passengers, but of such character that they must be regarded primarily as passenger vessels.

IIIb. Steamers carrying freight only or freight and some passengers, but of such a character that they must be regarded primarily as cargo vessels.

QUESTION No. 1. In order to insure safety at sea it is one of the first principles of design that the vessel should be seaworthy under all conditions of weather when loaded to a certain maximum draught, and that such a vessel should not be loaded so as to have freeboard less than a certain designed minimum. What is your opinion as to the advisability of prescribing by law or regulation this maximum draught and minimum freeboard for all classes of vessels?

QUESTION No. 2. What is your opinion as to the advisability of providing by law or regulation standards of hull construction, and how far should the rules of classification societies be recognized in matters pertaining to scantlings, structural arrangements, stability and freeboard?

QUESTION No. 3. Should the rules of classification societies be passed upon or given official recognition by a department of the government acting with discretionary authority under general laws relating to such subjects?

QUESTION No. 4. Let it be assumed that vessels should be designed to have ample structural strength, buoyancy and stability, when loaded to a specified maximum load draught, not only under all contemplated seagoing conditions when intact, but also under certain specified conditions of damage. Let it also be assumed that vessels should be fitted with efficient transverse watertight bulkheads or a combination of transverse and longitudinal watertight bulkheads and watertight decks so arranged that when a specified number of adjoining main compartments are in free communication with the sea the uppermost watertight deck to which all the bulkheads extend—and which we will hereafter call the "bulkhead deck"—is not brought nearer to the surface of the water in a smooth sea than would be indicated by a line drawn around

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the side at such a distance below the "bulkhead deck" as to provide for reserve buoyancy under this deck sufficient to keep the vessel from sinking in a rough sea. Let this line be called the "margin of safety line", and, for convenience, the reserve buoyancy of vessel referred to above may be expressed as a percentage of the displacement after damage and may be defined by freeboard below the bulkhead deck. This freeboard may be expressed as a fraction of the depth of the vessel amidships measured from the upper side of the bulkhead deck to the bottom of keel. Upon the above assumption what percentage of reserve buoyancy under the bulkhead deck do you recommend for vessels of classes Ia, Ib, IIa and IIb, under the following conditions:

(*a*) When any two adjoining main compartments are in free communication with the sea under the most unfavorable condition of stowage of said compartments.

(*b*) When any three adjoining main compartments are in free communication with the sea as in preceding condition.

(*c*) When any four adjoining main compartments are in free communication with the sea as in preceding condition.

QUESTION No. 5. Referring to Class IIIa and Class IIIb, it is recognized that it would possibly be detrimental to legitimate business interests if watertight transverse bulkheads were located closer than required by present rules of standard classification societies. Therefore, in Classes IIIa and IIIb, whereever addition transverse bulkhead sub-division is impracticable, it would seem desirable to arrange for lifeboats at davits on each side of the vessel sufficient to accommodate all persons on board.

(*a*) What is your opinion as to the practicable degree of transverse bulkhead sub-division of Classes IIIa and IIIb?

(*b*) What is your opinion as to the practicability of providing for Classes IIIa and IIIb ample boat capacity at davits on each side of vessel for all persons on board?

QUESTION No. 6. Is it considered necessary to formulate and prescribe rules and curves which will fix the "margin of safety line" for vessels of the various classes?

QUESTION No. 7. What is your opinion as to the advisability of prescribing by law or regulation for each of the classes the maximum number of adjacent main compartments which, under the most unfavorable conditions of stowage and weather, could be flooded without imperiling the safety of the vessel?

QUESTION No. 8. What is your opinion as to the maximum number of such compartments which should be prescribed?

In submitting your answer, it is requested that you make such further sub-division of classification as you may consider expedient or necessary with especial reference to the size of vessel and trade in which employed.

QUESTION No. 9. Is it considered necessary to formulate and prescribe rules for the construction and spacing of watertight bulkheads for vessels in the above noted classes?

QUESTION No. 10. What is your opinion on the following questions:

(*a*) As to the advisability of making the "bulkhead deck" continuous fore and aft? As to making it extend only outside of the machinery spaces?

(*b*) As to introduction of watertight decks or flats below the "bulkhead deck", especially at forward end of vessel?

(*c*) As to the fitting of continuous or partially continuous fore and aft watertight wing bulkheads providing fuel space and at the same time watertight compartments, tending to preserve buoyancy in the event of damage due to collision or otherwise?

(*d*) As to the necessity for openings in main transverse and longitudinal watertight bulkheads (except as absolutely necessary for the trimming of coal) when access between compartments can be provided by going to an upper deck at level of top of bulkhead and down through a deck opening into adjacent compartments?

(*e*) In view of the difficulty of fitting efficient watertight hatches in the bulkhead deck, what is your opinion as to the practicability and desirability of substituting therefor watertight trunks to the deck or decks overhead?

(*f*) Where watertight doors are fitted in watertight bulkheads is it necessary that they be mechanically operated from the bridge?

(*g*) Is it necessary that all watertight doors in bulkheads be capable of operation at the door?

(*h*) Is it necessary that all watertight doors in bulkheads be mechanically operated from the bulkhead deck?

QUESTION No. 11. As bearing upon questions of buoyancy and safety of vessels under all conditions, what is your opinion with respect to the fitting of air ports or side lights below the "bulkhead deck" and the limitations which should be imposed as to their use and location:

(*a*) As to height of lowest tier above deep load water line, amidships, and at the ends of the vessel?

(*b*) As to their being fixed or capable of being opened, and the minimum height above the deep load water line, forward, amidships, and aft, permissible for side lights which can be opened?

(c) Should the so-called fixed side lights be arranged to be opened in case of emergency to provide for desired egress from compartments under such conditions as prevailed in connection with the disastrous fire at the Hoboken piers some years ago? (This emergency provision might take the form of a movable light operated by a key kept in a locked glass case, with suitable instructions for its use.)

QUESTION No. 12. With respect to increasing the safety of vessels by the provision of a double bottom, what is your opinion as to the following for vessels of Classes Ia, Ib, IIa, IIb, IIIa, and IIIb:

(*a*) Do you consider it necessary or advisable to extend the double bottom to the underside of the deck immediately above the load water line?

(*b*) Do you consider it necessary or advisable to extend the double bottom up to or above the turn of bilge? Would you consider it sufficient to extend it to a height above base line equal to twice the depth of the double bottom at center line of vessel amidships?

(*c*) What is your opinion as to the desirable longitudinal extent of the double bottom outside of engine and boiler spaces?

QUESTION No. 13. With respect to provision of safety of vessels by increasing the maneuvering power through greater efficiency of rudder, do you consider it advisable to formulate rules specifying size of rudders and consequent maneuvering power of vessel since the lack of sufficient maneuvering power may have contributed toward maritime disasters resulting from collision on the high seas?

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Compensation of Compasses

A Study of the Influences Which Affect the Compass on Iron and Steel Vessels

By William C. Ward

AS AN independent magnetic entity with a field quite as complete as that of the earth from which its properties are derived, the modern iron ship presents a system of stresses and counter-stresses vastly more complicated than that of its terrestrial exciter. Fortunately, however, these admit of exact determination and correction within narrow limits while the vagaries of the earth's magnetic phenomena still find their explanations adrift in the realm of speculation. Diurnal fluctuations and the Aurora are vaguely laid to rising currents of ionized air; changes in compass variation, due to polar migration, are connected in some way with equinoxial precession, the northward rush of the solar system, etc., while the actual source of the earth's magnetism itself has yet to be satisfactorily accounted for.

By and large, so far as a ship's compass is affected, the terrestrial field merely exerts a directive pull on the magnetic needle, and for present purposes its influence ends when this force is once resolved into its equivalent rectangular components: the directive pull toward magnetic north in the horizontal plane to which the compass card is constrained, and the vertical element, which together cause the resultant dip of a freely suspended magnetic needle as it lays its axis parallel to the lines of force connecting the earth's magnetic poles. While designed mechanical difficulties prevent this vertical component from dipping a ship's compass card, it manifests itself by inducing polarity in vertical iron near the compass and in this indirect manner contributes its share toward driving the needles away from the N-S direction.

Two Grades of Iron

The material that goes into a vessel consists of two grades of iron, upon which the earth's magnetic field exerts different influences. Magnetically "hard" iron will retain indefinitely the polarity acquired by lying in a northerly and southerly direction, while constant hammering affords its particles every opportunity to arrange themselves in line with the trend of the earth's field. Thus, in a vessel built heading north, the hull and longitudinals will acquire permanent north polarity forward and south polarity aft; and one built heading northeast will develop a permanent north pole on the port bow and a corresponding south pole on the starboard quarter. But while the intensity of this sub-permanent magnetism will diminish in time, its characteristics will nominally remain unchanged, and after about two years no further alterations will be noticeable. "Soft"

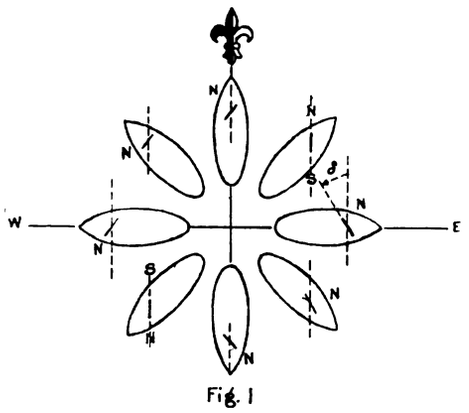

Fig. 1

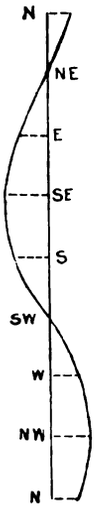

Fig. 2

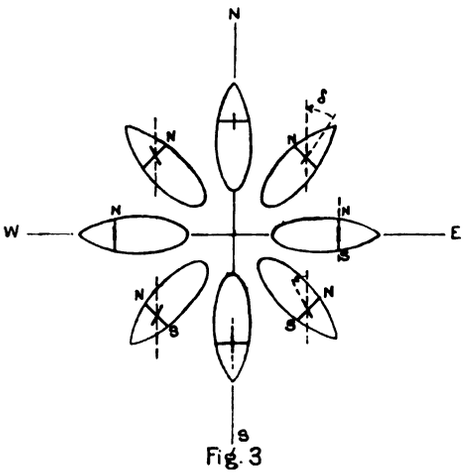

Fig. 3

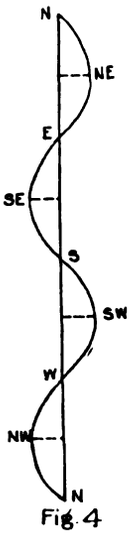

Fig. 4

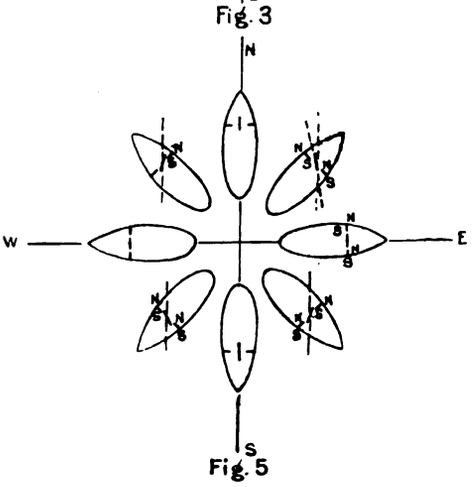

Fig. 5

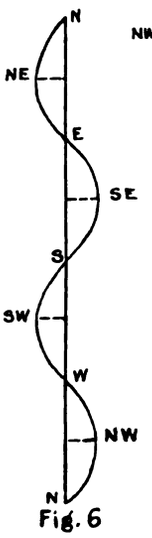

Fig. 6

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iron, on the other hand, will acquire magnetism very quickly when laid in an N-S direction, but loses it at once when turned at right angles to the earth's lines of force; its particles show no tendency to re-arrange themselves under the shocks incidental to riveting the metal in place. To the combined effect of these two classes of iron, with the occasional complication of a constant quantity, all compass errors are due; and however irregular the deviation table of a ship may appear, it always represents the algebraic sum of two kinds of deviation, "semi-circular" and "quadrantal", each of which is perfectly regular, symmetrical and easily separated from the other.

Semi-Circular Deviation

"Semi-circular" deviation is so called from the circumstance that it is easterly on 16 consecutive compass headings and westerly throughout the other semi-circle, as the ship's head swings 360 degrees in azimuth. It is caused partly by the sub-permanent magnetism of the hull and partly by the transient magnetism induced in vertical "soft" iron such as masts, davits, funnels, etc., by the vertical component of the earth's total force to north. When the compass is principally disturbed by the hull of the vessel the two points of zero semi-circular deviation correspond very closely to those points toward which the ship's head and stern lay while building, the deviation being easterly when that part of the ship which was south in building is east; westerly when it is west. Thus an iron ship built heading north will show westerly deviations on easterly headings and easterly deviations on westerly headings, there being no deflection on north and south, where the forces of both ship and earth act in the same straight line along the axis of the needle.

Fig. 1 shows in diagram the effects of sub-permanent magnetism in a vessel built heading northeast. On this heading there can be no deflection, for the north polarity on the port bow acts in line with the earth's force; but since it repels the north end of the needle, the directive pull of the earth is diminished. (The apparent inconsistency of this statement disappears when it is remembered that the north pole of the earth really possesses south magnetism.) As the ship's head swings to east the north polarity in the hull is drawn off to one side of the compass and repels it to the westward of magnetic north. On southeast this repelling force acts at right angles to the line along which the needle tends to lay itself under the earth's pull, and the deviation reaches its westerly maximum. Heading south, the westerly deflection decreases, vanishing at southwest, where ship and earth are again acting in the same straight line. Here, however, they pull together, and the directive power of the needle is increased. As the vessel swings westward, the north polarity again drives away from magnetic north, this time sending it off to the eastward; and so the easterly deviation continues throughout the rest of the semi-circle. When plotted on the ordinary Napier's diagram, easterly deviations to the right and westerly to the left of the graduated center line, these deviations will show a pure semi-circular curve as in Fig. 2.

The deviations caused by vertical "soft" iron are equally simple. The vertical component of the earth's total force (in north latitudes) induces north polarity in the lower and south polarity in the upper ends of all vertical and inclined elements. The combined effect, therefore, is polarity of a certain kind located at some fixed but often imaginary point in the vessel; and for this reason, like the fixed polarity of the sub-permanent magnetism in the hull, it must cause semi-circular errors. The sub-permanent magnetism, however, is a constant wherever the ship may be cruising, and the sine of its deviation is always proportional to that of the azimuth of the ship's head. The magnetism induced in vertical "soft" iron, on the other hand, varies, the sine of its deviation changing as the tangent of the dip of a freely suspended needle, and for this reason must be different for different latitudes.

Deviations Caused by Vertical Soft Iron

"Quadrantal" deviation is caused by the transient magnetism induced in horizontal "soft" iron, and derives its name from the remarkable fact that it is always zero on the four cardinal points, shows maxima on the intercardinals and is alternately easterly and westerly in the successive quadrants. Due to horizontal induction only, it does not change with the latitude, and is proportional, or more exactly its sine is proportional, to that of double the azimuth of the ship's head measured from a point halfway between magnetic north and the direction of the disturbed needle. These deviations, as found in practice on shipboard, are always easterly in the first and third quadrants; westerly in the second and fourth. From this it is evident that the total disturbing cause seems principally due to deck beams, and may be represented by a continuous thwartship bar of "soft" iron passing through the compass, as shown in Fig. 3. While the vessel heads north or south the bar is at right angles to the magnetic meridian, no magnetism is induced and there is no deviation. On the east and west headings, while the induced magnetism is maximum, it acts in line with the earth and there is no deflection. Between north and east, induced north polarity on the port beam drives the needle to the eastward; between east and south, to the westward; from south to west, to the eastward again, and in like manner, to the westward of north in the fourth quadrant. Laid down on a Napier's diagram as before, these deviations would show the quadrant curve in Fig. 4.

Quadrantal Deviation

Now it happens that a non-continuous, horizontal, thwartship "soft" iron bar also causes quadrantal deviation, but it is easterly in the second and fourth quadrants and westerly in the first and third. In Fig. 5, as the vessel swings from north toward east it is the south end of the northerly half of the bar that acts on the compass, and the needle must, therefore, be drawn to the westward instead of being driven to the eastward as before. In like manner the signs of all the deviations will be reversed; the curve in Fig. 6 can be made to exactly cancel that of Fig. 4, and thus the remedy for quadrantal deviation suggests itself.

It has been stated that while the semi-circular errors due to vertical "soft" iron vary with the latitude, those attributed to horizontal "soft" iron do not, yet they both depend on a force which itself is constantly changing as the ship moves from equator to pole. The explanation is that in high latitudes where the earth's force is chiefly dip the vertical iron receives a large amount of magnetism and exerts it accordingly. The horizontal iron is weakly magnetized and the horizontal pull on (directive force of) the needle is weak in proportion to the magnetism induced in the ship. At the magnetic equator, however, there is no dip and the vertical iron can get no magnetism to exert, while the increased power induced in horizontal "soft" iron has to deal with a needle whose directive force and resistance to its influence has increased exactly as much as its own disturbing powers.

"Constant" deviations are rare, and where found are generally more apparent than real. They usually result from an error in the assumed

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direction of magnetic north, and manifest themselves by introducing a uniform error affecting the deviation on every point of the compass. The placing of a binnacle out of the fore-and-aft line amidships leads to an arrangement of "soft" iron that is unsymmetrical with respect to the compass, which an inspection of Fig. 7 will show causes a constant easterly deviation on all headings. Many cases arise, however, in which a purely fictitious "constant" exists. The United States revenue cutter Bear, after a serious collision off the Farallons in 1904, began to make landfalls on the port bow, continually fetching up to the right of her destination. It was assumed that the forward part of the vessel had been sprung in some manner, and this was confirmed by the fact that she carried a taut starboard helm. An arbitrary quarter-point "constant" easterly deviation applied to the deviation table was found to correct all courses very nicely.

Theory of Deviation

Many years ago the pioneers of compass compensation evolved a very complete and elaborate mathematical theory of deviation based on the hypothesis that the magnetism of a ship is partly the permanent magnetism of hard iron and partly transient magnetism induced in soft iron; that the latter is proportional to the intensity of the inducing force, and that the length of the compass needle is infinitesimal compared to the distance of the nearest iron. From this standpoint their formulae are exact; but however necessary these intricate studies may have been to the development of the subject, the fact remains that a knowledge of them cannot enable one to compensate a compass more accurately than by the slip-shod tentative methods that are in vogue today. With the old "starboard angle" type of binnacle a mathematical analysis of deviations was often necessary, but where rectangular correctors are used all theory beyond that already given may safely be ignored.

The obvious manner of effecting compensation is to place magnets near the compass, wrong end to, so as to counteract the magnetic forces of the ship, and in the old starboard angle method this was literally done. The vessel was swung through 360 degrees, the deviation on every other point determined, and after much tedious computation resolved into its component parts. The computed angle between ship's head and the axis of an imaginary magnet whose effect would be equivalent to the sub-permanent magnetism of the hull determined the position of the corrector. It was then necessary to place the corrector in the binnacle at the computed angle, head the vesesl on a magnetic cardinal point and raise or lower the corrector tray until the compass gave the correct magnetic reading.

Sub-Permanent Magnetism

In the rectangular system the sub-permanent magnetism is resolved into its fore-and-aft and thwartship components, and each of these corrected separately. The vessel is headed on one of the magnetic cardinal points, say north, by means of a range on shore whose magnetic bearing is known, or by a table of time azimuths of the sun previously prepared for the particular latitude and local apparent times at about ten-minute intervals. The quadrantal deviation on cardinal points being zero, all error observed is semi-circular. Also the fore-and-aft component of the semi-circular deviation is inoperative because it is acting north and south. Any difference between the ship's head by compass and north must, then, be due to the thwartship component and can be corrected with a thwartship magnet. If, instead of heading north by compass the card is found to read N. ½ E., there is half a point westerly deviation and a magnet placed in the tray with its south end to starboard will, when raised or lowered in the binnacle to a sufficient distance from the compass, draw the compass north to starboard until its north mark is opposite the lubber's point. Then, heading the vessel magnetic east, the fore-and-aft component is compensated out. Should the compass read E. ½ N., the half point easterly deviation can be removed with a fore-and-aft magnet, north end forward to drive the compass north off where it belongs, or until the compass reads east. The compensation should be checked on south and west. It is not necessary that the correctors be placed in the binnacle itself, but the thwartship vertical plane passing through the center of the compass must bisect every fore-and-aft correcting magnet, and the vertical fore-and-aft plane passing through the center of the compass must bisect every thwartship magnet; otherwise the two poles of the correctors would exert different influences on the compass, spoil the symmetry of the semi-circular curve and set up new semi-circular deviations of their own.

Correction of the quadrantal deviation is a more simple process. The semi-circular error out of the way, it is usual to head the ship on some intercardinal point where quadrantal deviations are maximum. The principle of the non-continuous soft iron bar is utilized in the form of the two iron balls or rods which are fitted to the arms of the binnacle. The correction consists simply of moving the correctors in or out, each the same distance from the compass bowl, until the deviation is removed and the vessel heads by compass exactly on the intercardinal point on which she was laid by the shore range or sun azimuth. As quadrantal deviation does not change with either latitude or time, the correction once made may be relied on as long as the disposition of iron about the vessel remains unaltered.

Residual Deviation

There will always be some residual deviation after these corrections have been made, but there is rarely any excuse for their exceeding one-fourth of a point on any heading if the work has been carefully done. After the first compensation has been made and the ship shows considerable deviations while being swung for residuals, a few patient readjustments of correctors and compromises between the balls and permanent magnets will always greatly reduce them.

A constant deviation cannot be conveniently corrected in a standard compass. A real constant is extremely rare, but when it does occur it is the same for every heading and can easily be allowed for. In steering compasses, which are sometimes unavoidably placed in bad positions as regards surrounding iron, large constants are frequently observed. They may be corrected, however, for steering purposes, by altering the lubber's point, to starboard if the deviation is easterly and to port if westerly.

A vessel in north latitude has in the upper ends of its vertical elements a south polarity. Thus the frame ends, davit heads, stanchions, etc., continually exert a force tending to draw downward the north end of the needles in bridge compasses. So long as the ship is on an even keel there can be no resulting deviation, but the moment she heels over some of these vertical elements will swing off to one side of the still horizontal bowl and exert a sidewise pull which can cause deflections. Also all the beams and other horizontal elements become inclined and acquire magnetism from the vertical component of the earth's force. Their upper ends become strong south poles and

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draw the compass north toward the windward or high side, thus upsetting for the moment the entire magnetic system of the vessel. When the ship rights herself these disturbances vanish, only to reappear on the other roll with reversed signs pulling in the opposite direction. In a seaway these forces cause the compass card to oscillate from side to side to such an extent that it becomes next to impossible to hold the vessel steady on her course. The amount of heeling error can be very closely computed from the results of a set of observations on board and on shore with a vibrating instrument which is only to be found in navy yards. This can be done and the correction made without heeling the vessel at all. Such instruments, however, are not ordinarily to be had, and the demands for quick action in the modern merchant marine do not admit of the necessary delay.

Heeling Error

The simplest manner of compensating the heeling error, and as efficient a one as any other, is to place the ship in the trough of the sea and let her roll. Then put the heeling magnet, latitude pole uppermost, in the bottom of its tube in the binnacle and raise it until the oscillations of the card cease.

The presence of this permanent north polarity (in north latitudes) directly beneath the center of the compass needle will produce no deviation so long as the vessel is on an even keel. When she heels, however, it will be drawn off to the windward side and counteract the disturbance due to the south magnetism in the upper ends of the now-inclined beams. In placing the heeling magnet it should be secured as low as possible in the binnacle so that the quadrantal spheres and the compass needles may remain more nearly in the same magnetic field. In general the mutual effect of all correctors upon each other is to modify their several effects, and it is largely due to this circumstance that subsequent compromises and adjustments are so often necessary. These are, however, small in amount and their character will indicate at once the type of corrector which must be moved to offset them.

The H. D. Bendixsen Ship Building Co., Eureka, Cal., is building a steam schooner for the Olson & Mahoney Co., of San Francisco, to be 205 ft. long, 41 ft. beam and 15 ft. deep, to be delivered in September.

Torpedo Boat Destroyer Duncan

The torpedo boat destroyer Duncan, built by the Fore River Ship Building Corporation, underwent her standardization trials during the week of July 5 on the Rockland course.

The Duncan is 305 ft. 3 in. over all, 30 ft. 6 in. beam, fitted with Curtis marine turbines, developing 16,000 h. p. on twin screws, designed for speed of 29 knots. For economy under cruising conditions a compound reciprocating engine is connected by means of a movable clutch to the forward end of the turbine shaft. The steam after passing through the engine enters the turbine, which acts as a low pressure unit under this condition. The contractor's preliminary runs indicate that the vessel will be very economical. It is expected that she will be complete ready to deliver to the navy yard, Boston, Mass., early in August.

The Argentine battleship Rivadavia will leave the works of the Fore River Ship Building Corporation, Quincy, Mass., on Aug. 3, 1913, and will proceed to New York, where arrangements have been made to dock the vessel in No. 4 dry dock at the Brooklyn navy yard, where necessary underwater overhaul and painting will be completed. The official trials of the vessel will commence at Rockland, Me., about Aug. 11, 1913. The United States navy department at the request of the Argentine naval commission and the contractors have consented to conduct the standardization and economy runs of this vessel, which work will be done by the Board of Inspection and Survey, navy department.

Obituary

Charles H. Cramp, former head of the ship building firm of Wm. Cramp & Sons, died on June 6 at the home of his son, Courtland E. Cramp, Philadelphia. He was born in Philadelphia on May 9, 1828, and was the son of William Cramp, who founded on the Delaware river in 1830 a shipyard which has since become one of the largest shipbuilding plants in the world. Charles Cramp, after graduating from the high school, entered the shipyard of his uncle Birely and in 1859 joined his father, the firm being known as Wm. Cramp & Sons. Upon the death of Wm. Cramp in 1879, Charles H. Cramp became the head of the business. The firm under Charles Cramp's direction made a great name for itself in the building of warships both for the American navy and other navies.

Edwin S. Cramp, son of the late Charles Cramp and grandson of William Cramp, died at his home in Philadelphia on June 20. He was the general manager of William Cramp & Sons Ship & Engine Works until his retirement from active business about ten years ago. He was born in Philadelphia in March, 1853.

John Kingsbury Dean, of Dean Bros. Steam Pump Works, Indianapolis, Ind., died early in June at the home of his parents in Indianapolis. Mr. Dean was forty-four years old and was a graduate of Cornell University.

Personal

Holden Evans has resigned from the Seattle Construction & Dry Dock Co.

W. L. Gazzam, president of the Kitsap County Transportation Co., Seattle, Wash., is in the east on a business trip.

Daniel J. Keefe, former president of the International Longshoremen's Association, has resigned as commissioner general of immigration.

Howard Shepherd has resigned as treasurer of the Toledo Ship Building Co., to become vice president of the Ohio Savings Bank & Trust Co.

P. A. S. Franklin has been elected to fill the vacancy on the board of directors of the International Mercantile Marine Co., caused by the death of Clement Griscom.

Capt. M. Mulholland has recently incorporated a company known as the Mulholland Hatch Fastener Co. to market the device which bears his name. He has also secured control of the simplex and security type of fastener.

Lieut. Commander Hutchinson I. Cone, formerly chief of the naval bureau of steam engineering with the rank of rear admiral, has been detached from the bureau and ordered to duty as executive officer of the battleship Utah.

The twin-screw power yacht Natoma, building for Charles H. Foster, of Chicago, was launched from the yard of the Gas Engine & Power Co., Morris Heights, N. Y., on June 26. The Natoma is 112 ft. keel, 17 ft. beam and is equipped with two 165-H. P. Speedway motors. Her deck panels, door panels, saloon and state room bulkheads are Nevasplit panels, made by the Keyes Product Co., 71 West Twenty-third street, New York City.

The Hamburg-American Steamship Co. has invited tenders from American ship yards for six ships.

Maurice H. Thatcher, member of the Isthmian canal commission and head of the department of civil administration, has resigned to take effect on the expiration of his vacation leave Aug. 8, 1913.

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The "Niagara" Afloat again

THE PERRY MEMORIAL DESIGN TO BE ERECTED AT PUT-IN-BAY

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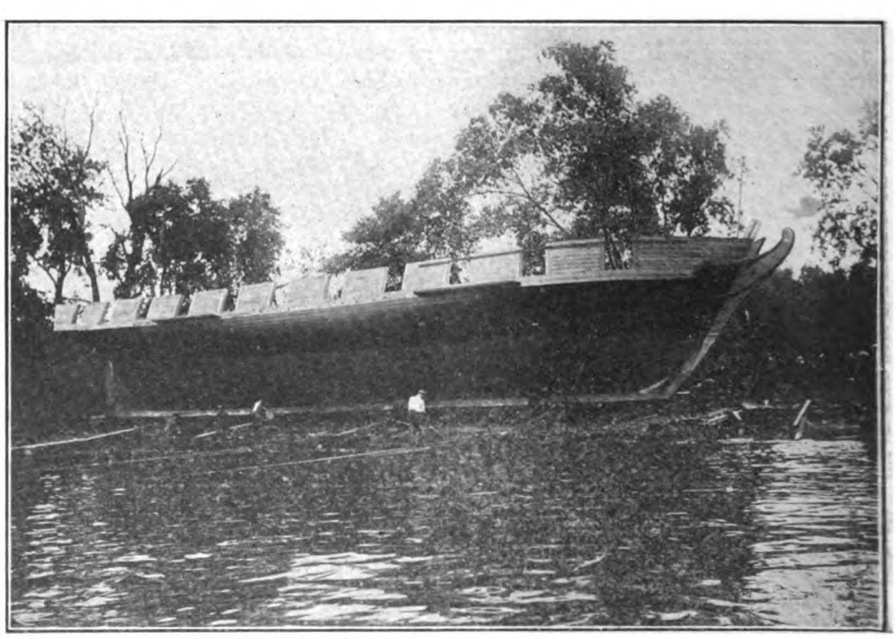
COMMODORE Oliver Hazard Perry's flagship, the Niagara, is floating again. Rebuilt in such a manner that it duplicates the original beam for beam, the famous old brig slid into the waters of Misery bay, at Erie, Pa., Saturday, June 7. Due to an error in signal arrangements from the tugs Commodore Perry and Erastus C. Knight, the launching was a failure. When the Niagara struck the water, it halted, swayed for a moment and the crashing of "butter boards" beneath told the big crowd of onlookers that the brig was stuck in the mud. That happened before noon. After six o'clock, the task was accomplished by the tugs which tried eight times to pull the Niagara from the mud, without success. Ropes snapped each time until a double line of hawsers was connected which held.

The old brig was rebuilt in stocks, which stood 20 ft. from the water line. Greased timbers extended into the water 20 ft. more, then lay on supports for a distance of 30 ft. on the water level. The angle of the timbers from the stocks to the water was about 15 degrees. When hawsers had been connected with the tugs, the signal, a double whistle from the Commodore Perry, was sounded and the ropes were cut. Reaching the water line where the timbers extended on a level over the water, the Niagara halted.

For nearly seven hours then, the tugs pulled, but the Niagara stuck stubbornly in the mud. She lay in about 5 ft. of water. The crowd dwindled and by six o'clock, only a handful of persistent patriots were present to see the Niagara right herself, swing into the water and stand upright as gracefully as a modern yacht.

Hansen & Lund, shipbuilders, of Erie, who reconstructed the wreck, accomplished a creditable task, according to authorities. From a water-soaked mass of ribs, they have created a brig which duplicates in every line, pictures and historic descriptions of the Niagara as she was in 1812. The lines of the bow and stern are perfect even to the quaint carvings and the interior is just as it was when begrimed sailors handed up keg after keg of powder from the hold to the deck, during the battle of Lake Erie.

No sub-contracts were let since the raising. Each contractor was awarded the bid to do a particular task. Materials he needed were obtained from various sources, many of them never reported to the Pennsylvania commission on Perry's Victory Centennial, which awarded bids. The first contract let was to the Gillespie Co.,



THE NIAGARA ON THE STOCKS

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divers, with headquarters in Pittsburgh. Their men inspected the hulk of the Niagara as it lay under the waters of Misery bay and later, reported what should be done to raise her successfully. Paasch Brothers, of Erie, then won the contract to raise the wreck. It was a tedious work, but was done well after three months of bitter, winter weather.

The Fred Baker Co., of Erie, is erecting spars obtained from Michigan forests. One of the most difficult tasks was that of getting spars of the right length and weight, and Capt. William L. Morrison, who is in active charge of the Niagara, traveled far and near for the purpose. The Baker Co. finally succeeded in getting the right timber. The spars are 60 ft. high and are perfect specimens of Michigan pine.

The Upson-Walton Co., of Cleveland, O., was awarded the contract for sails and rigging. Their men are at work now on the Niagara, measuring and planning. The Bay State Iron Works, of Erie, is making guns after the pattern of those with which Perry repulsed the British. There will be a cannon at each of the ten gun-ports on both port and broadsides and one at bow and stern.

Raising Level of Lake Level

Construction of a submerged dam or weir in the Niagara river at Gill creek on the American side, and at Hog Island on the Canadian, has been recommended to congress by the International Waterways Commission. The recommendation follows an investigation of more than 10 years. The object of the proposed dam is to raise the level of Lake Erie and its upper waters, the commission emphasizing the fact that the value of the proposed work to Lake Erie ports could hardly be estimated. Extensive improvements to harbors and docks would also result, it was pointed out.

It is proposed to raise the level of the Niagara river 3 ft. for a distance of 1½ miles, and the cost of the weir and the resulting works to avoid damage to property is estimated at $3,500,000. It is also pointed out by the commission that the weir would do away with any injurious effect upon the Lake Erie level by diversion of waters at Niagara Falls for water power purposes.

At low water level the Niagara river at the Buffalo water works would be raised 1.08 feet, and at flood 0.19 foot; the level of Lake Erie would be raised 0.51 foot at extreme low water, 0.39 foot at mean, and 0.11 foot at extreme flood stage. The plan would raise the mean level of Lake St. Clair 0.23 foot and that of Lake Huron 0.09 foot.

Commerce of Lake Superior

The commerce of Lake Superior as measured by the canals at Sault Ste. Marie reached 12,113,613 net tons during June, exceeding the May movement by 737,418 tons. This is the largest amount of freight that has ever passed through the canal in any one month. The total movement to July 1 was 25,395,363 tons as against 19,850,770 tons for the corresponding period during 1912, an increase of 5,544,593 tons. Following is the summary:

EAST BOUND.

	To July 1, 1912	To July 1, 1913
Copper, net tons	30,689	33,532
Grain, bushels	18,666,378	32,823,793
Building stone, net tons	2,282	273
Flour, barrels	2,028,112	2,671,671
Iron ore, net tons	12,925,044	15,253,802
Pig iron, net tons	.....	9,665
Lumber, M. ft. B. M.	178,695	166,309
Wheat, bushels	47,680,158	53,572,711
Unclassified freight, net tons	73,930	118,663
Passengers, number	5,994	6,975

WEST BOUND.

Coal, anthracite, net tons	224,908	1,004,028
Coal, bituminous, net tons	3,715,397	5,492,091
Flour, barrels	.....	163
Grain, bushels	.....	.....
Manufactured iron, net tons	197,811	135,530
Iron ore, net tons	3,188	17,192
Salt, barrels	295,687	265,279
Unclassified freight, net tons	336,950	320,678
Passengers, number	7,197	7,635

SUMMARY OF TOTAL MOVEMENT.

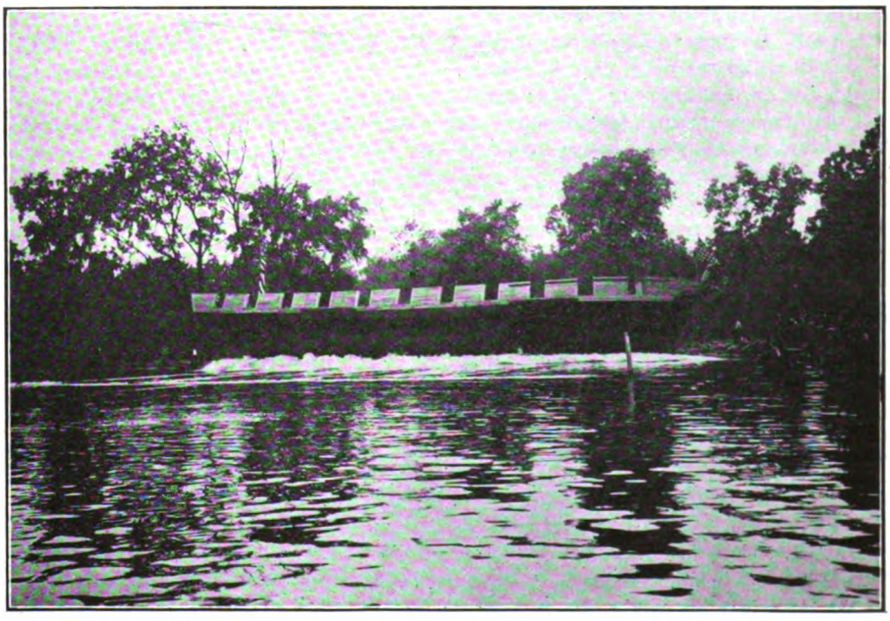
East bound, tons	15,329,385	18,286,122
West bound, tons	4,521,385	7,109,241
	19,850,770	25,395,363
Vessel passages	6,783	7,180
Registered tonnage, net	16,395,913	18,343,839

New Hopper Dredge

William Simons & Co., Ltd., Renfrew, launched on June 20, complete with all machinery on board, and with steam up ready for trials, a 700-ton hopper steamer, being the second of a fleet of eight dredging vessels they have on hand for the naval port, Emperor Peter The Great, now under construction at Reval by the Imperial Russian government for warship purposes. The vessel is propelled by compound surface condensing marine engines, supplied with steam from a mild steel horizontal multitubular boiler constructed for a working pressure of 120 lbs. per sq. in. Powerful steam gear is provided for rapidly raising and closing hopper doors.

Handbook of Tools

The Cleveland Punch & Shear Works, Cleveland, recently issued hand book No. 5 showing machines and small tools for the fabrication of iron and steel. The company recommends standard tools to every concern operating one or more punching machines, as they cost less and can be shipped immediately from stock. The book is full of suggestions as to standardization of equipment and the company is always ready to assist in the installation of such changes as will be of benefit to the users of its tools. The company makes a specialty of contracting for the year's requirements on chisel blanks and rivet sets for pneumatic hammers, beading tools, punches, dies and other small tools. The hand book will be mailed to any one upon request.



LAUNCHING THE NIAGARA

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New Welland Canal

Tenders Are Now Solicited for a Portion of the Work—Route of the Canal

TENDERS have now been solicited for the construction of a portion of the new Welland canal, the route of which has finally been determined upon. The new canal will follow the course of the present canal from Port Colborne, Lake Erie, to Allanburg, Ont., half way across the peninsula. From Allanburg an entirely new cutting will be made, crossing the present canal just below lock 25, the water level of the two canals at that point being the same, 568 ft. above sea level. The new canal will again cross the present one below lock 11, which is 382 ft. above sea level. The plans for the canal were prepared by J. L. Weller, engineer in charge, and the particulars incorporated in this article were supplied by him to the *Canadian Railway and Marine World.*

Route of the Canal

The new canal will be entered from Lake Ontario at the mouth of Ten Mile Creek, about 3 miles east of Port Dalhousie, the entrance to the present canal. The total length of canal from lake to lake will be 25 miles, and the difference in level between the two lakes, 325½ ft., is to be overcome by seven lift locks, each having a lift of 46½ ft. These locks are to be 800 ft. long by 80 ft. wide in the clear, and with 30 ft. of water over the miter sills as extreme low stages in the lakes. The width of the canal at the bottom will be 200 ft. and at first the canal reaches will be excavated to a depth of 25 ft. only, but all structures will be sunk to the 30 ft. depth, so that the canal can be deepened at any future date by the simple process of dredging out the reaches.

A new western breakwater, consisting of an immense rubble mound of stone from the excavation north of Port Colborne, and terminating in a timber and concrete head block located some 2,000 ft. farther out in the lake than the present breakwater, will be built to insure quiet water in Port Colborne harbor during storms, which is not the case now, the present breakwater not being far enough out in the lake to deaden the swells. The outer harbor at Port Colborne now has a 22 ft. depth of water at ordinary stages of the lake, which is as much as is available at most of the lake ports and in the channels connecting the lakes at present, and the deepening of this portion of the harbor may be left for a few years until the connecting channels in the lakes allow deeper navigation. The inner harbor at Port Colborne will be deepened to the proposed new depth, and the old locks and regulating weir now in the center of the village will be entirely removed.

The present rock cut from Port Colborne to Humberstone will be deepened and widened on the west side, and just below Humberstone a thorough cut will be made across the point now forming Ramey's Bend, to materially straighten the canal. The material from this cut will be nearly all rock and will be used to form the breakwater previously mentioned. A guard lock will be built in the rock cutting a short distance below Humberstone, and when this new cutting is ready for navigation a regulating weir will be built across the abandoned portion of the present canal, which will be used as a by-pass to furnish water to the canal. This lock and regulating weir will control the elevation of the summit level of the canal, which it is proposed to keep at the level of extreme low water in Lake Erie, viz.: 568 ft. above sea level.

Deepened and Widened

From Ramey's Bend to Welland the present canal will be deepened and widened by excavating a strip along the western bank. Instead of building a new aqueduct at Welland, to carry the canal over the Welland river, it is proposed to raise the level of the river to that of the summit level of the canal, viz.: 568 ft., by means of a dam across the river at Port Robinson. This dam will be provided with a large overflow and regulating weir, which will control the elevation of the summit level, allowing any surplus water to overflow into the old Welland river and pass out into the Niagara river, at Chippewa, as at present. A sufficient quantity of water will be allowed to run constantly to keep the river clean.

The present aqueduct at Welland will be dredged out, also the bank between the canal and the river, which latter will be utilized between Welland and Port Robinson, instead of the present canal, being somewhat straighter and entailing considerably less excavation. At Port Robinson a cut will be made through the present bank between the canal and the river, through which vessels will again enter the canal prism.

The raising of the Welland river, above Welland, will flood some 1,600 acres of low land adjoining the river bed. This land is not of any great value, as it is flooded every spring by the flood water in the river and is principally used for pasturage. The Wainfleet Tsp., adjoining the Welland river on the south side, consists principally of low-lying ground which drains into the Welland river, and to prevent damage to this land on account of the raising of the river, it will be necessary to open up most of the ditches from the point of their present entrance to the river to the intended high water mark.

Turning River into Canal

The turning of the Welland river into the canal will pollute the waters which are at present used by the towns of Welland, Thorold and Meritton, and by the city of St. Catharines for domestic purposes. This may necessitate the construction of extensive filtering plants, which scheme is not looked upon with favor by those interested. An alternative scheme, to lay a pipe line from Lake Erie to the reservoirs of the different municipalities, through which clean water would be continuously pumped, is under consideration and appears to be the most feasible scheme available.

Between Port Robinson and Allanburg what is known as the deep cut (deepest cutting 66 ft.), will be deepened and widened by cutting a slice off the western bank. Allanburg is now the junction of the present and old Welland canals, and the water required for the latter, which is quite considerable, on account of the numerous power developments along it, is taken into the canal through a weir at this point.

In connection with the construction of the new canal, it is proposed to close the present old canal entirely between Allanburg and Marlatts bridge, near Thorold, first building a new weir at the head of lock 25 of the present canal, to supply the above mentioned water. A dam will then be thrown across the old canal at

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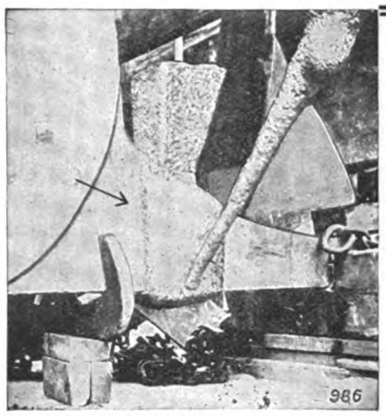

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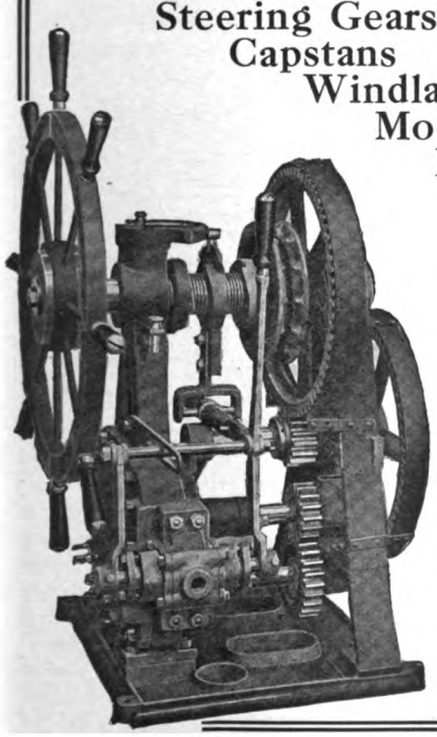

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THE FEDERAL GRAPHITE MILLS

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Allanburg, and the old bed of the canal between the dam and Marlatts bridge will be utilized as a dumping ground in which to place the material removed from the above water in widening the deep cut. This will form a very convenient dumping ground, and the old canal will become more self contained, as at present the entrance works are situated at an inconvenient distance from the remainder of the canal.

If it is desired to continue navigation on the old canal, entrance may be had to it through lock 25 of the present canal, when the new canal is completed, by making a short cut through the bank separating the two waterways.

A pair of twin guard gates are located on the proposed canal, near the southerly limits of the town of Thorold, and a short distance north of them will be located lock 7, the head of this lock being directly opposite the head of lock 24 on the present canal. The portion of the present canal between locks 25 and 24, together with a pond of about 27 acres, formed by flooding the upper valley of the Ten Mile creek, will be utilized as a regulating basin from which water to fill lock 7 will be drawn. This method of drawing water from a side pond, instead of directly from the canal above, avoids the formation of objectionable currents and surges in the canal and locks, and is the method adopted for filling all of the locks.

Navigating the Old Canal

Below lock 7 will be a short reach of canal, with an adjacent side pond or regulating basin having a surface area of about 84 acres, and immediately below will be located twin locks 6, 5 and 4 in flight. These three locks will overcome a descent of 139½ ft. One flight will be used for down bound vessels and the adjoining flight for up bound, a double flight being required to save long delays in the passage of vessels through the canal.

The Grand Trunk railroad main line between St. Catharines and Niagara Falls will cross over the foot of twin locks 4, by means of two short bascule lift bridges.

The Grand Trunk railroad Port Dalhousie-Welland branch is situated just where the new locks are to be built, and it will be necessary to divert it some distance to the west. The diverted line will bear the same relation to the new canal as the present line does to the present canal, following upon the west side of the locks, but remaining on the west side of the canal for some distance above the present lock 25, when it will cross over the new canal on a bascule lift bridge to the east side.

From lock 4 the new canal will cross the meadow to the north, following in part the bed of Ten Mile creek till it crosses the present canal at the foot of lock 11, at an elevation of 382 ft. above the sea level, which is the level of the present canal at that point. This will enable small vessels, which wish to do so, to use the Port Dalhousie entrance as at present, as far as lock 11.

Deep Excavation at Homer

Lock 3 will be located north of the present canal, and at its head on the east side will be an equalizing basin, or pond, of 150 acres. Below lock 3 a heavy cutting will be required through the village of Homer to the bed of Ten Mile creek again, above Carleton street, and just below Carleton street lock 2 will be located. It was difficult to find a location for this lock on account of the lack of rock for a foundation, but eventually a suitable foundation was found at the present site. The canal at the head of lock 2 will be at an elevation of 335½ ft. above sea level, and will flood about 200 acres of land in and adjoining the bed of Ten Mile creek. Below lock 2 the canal will follow the bed of the creek to the lake, lock 1 being situated just below the Lake road. The pond at the head of lock 1 will cover an area of 107 acres.

The outer entrance piers in Lake Ontario will be placed about a mile and a half from shore, where the depth of water is 30 ft. A wide channel will be dredged from these piers to lock 1. The sides of this channel will be protected near the shore end by reinforced concrete cribs, with concrete superstructures, alongside which vessels may lie. From the shore line of the lake to the outer entrance piers an embankment about 500 ft. wide will be formed on either side of the channel, from material excavated from the canal between the lake and Thorold. For the purpose of conveying this material from the different contracts to the lake, the railways and canals department will build a double-track railway along the west side of the canal from the foot of the flight locks near Meritton to the lake, and temporary trestles will be built out in the lake on either side of the harbor, from which to start the dumps. The railway will also be utilized to haul crushed stone from the site of the flight locks to locks 1, 2 and 3, where it will be used for making concrete. The contractor for the rock excavation from the site of the flight locks will, under his contract, be obliged to crush a sufficient quantity of the good rock taken from his excavation to supply all the crushed stone required for making all the concrete for the different locks and structures.

June Ore Shipments

Ore shipments during June were 7,974,444 gross tons as against 7,567,555 gross tons for June, 1912, an increase of 406,889 gross tons. The increase over shipments for June, 1911, is 3,154,448 gross tons and over June, 1910, which up to that time was the record movement for an early month, 657,852 gross tons. It is quite likely that the July movement will reach 8,000,000 tons, and the expected 50,000,000-ton movement for the present season will easily be attained. Following are the shipments by ports during June and up to July 1, with corresponding data for the preceding year:

Port.	June, 1912.	June, 1913.
Escanaba	849,059	845,414
Marquette	561,976	532,736
Ashland	811,029	774,761
Superior	2,348,608	2,377,078
Duluth	1,551,214	1,895,728
Two Harbors	1,445,669	1,548,727
	7,567,555	7,974,444
1913 increase		406,889

	To July 1, 1912.	To July 1, 1913.
Escanaba	1,641,946	1,800,601
Ashland	1,332,801	1,509,702
Marquette	918,890	1,059,776
Superior	4,344,331	4,677,349
Duluth	2,845,478	3,995,948
Two Harbors	2,607,223	3,081,666
	13,690,671	16,125,042
1913 increase		2,434,371

Lake Erie Ore Receipts

Out of a total iron ore movement of 7,974,444 tons during June, 6,214,648 tons were received at Lake Erie ports, distributed as follows:

Port.	June, 1913.
Buffalo	932,468
Erie	106,145
Conneaut	1,276,678
Ashtabula	1,234,521
Fairport	379,460
Cleveland	1,416,106
Lorain	612,071
Huron	104,768
Sandusky	.....
Toledo	127,848
Detroit	24,583
Total	6,214,648

At a meeting of the directors of the Toledo Ship Building Co., July 8, the resignation of H. I. Shepherd as secretary and assistant treasurer was accepted and A. D. Black, purchasing agent of the company, elected in his place. Edward Hopkins, naval architect for the company, was elected member of the board of directors to fill the vacancy left by Mr. Shepherd.

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